SCIENCE DIGEST

MARCH 1968 • 50 CENTS ICD

SLEEP LEARNING

How much stays put?

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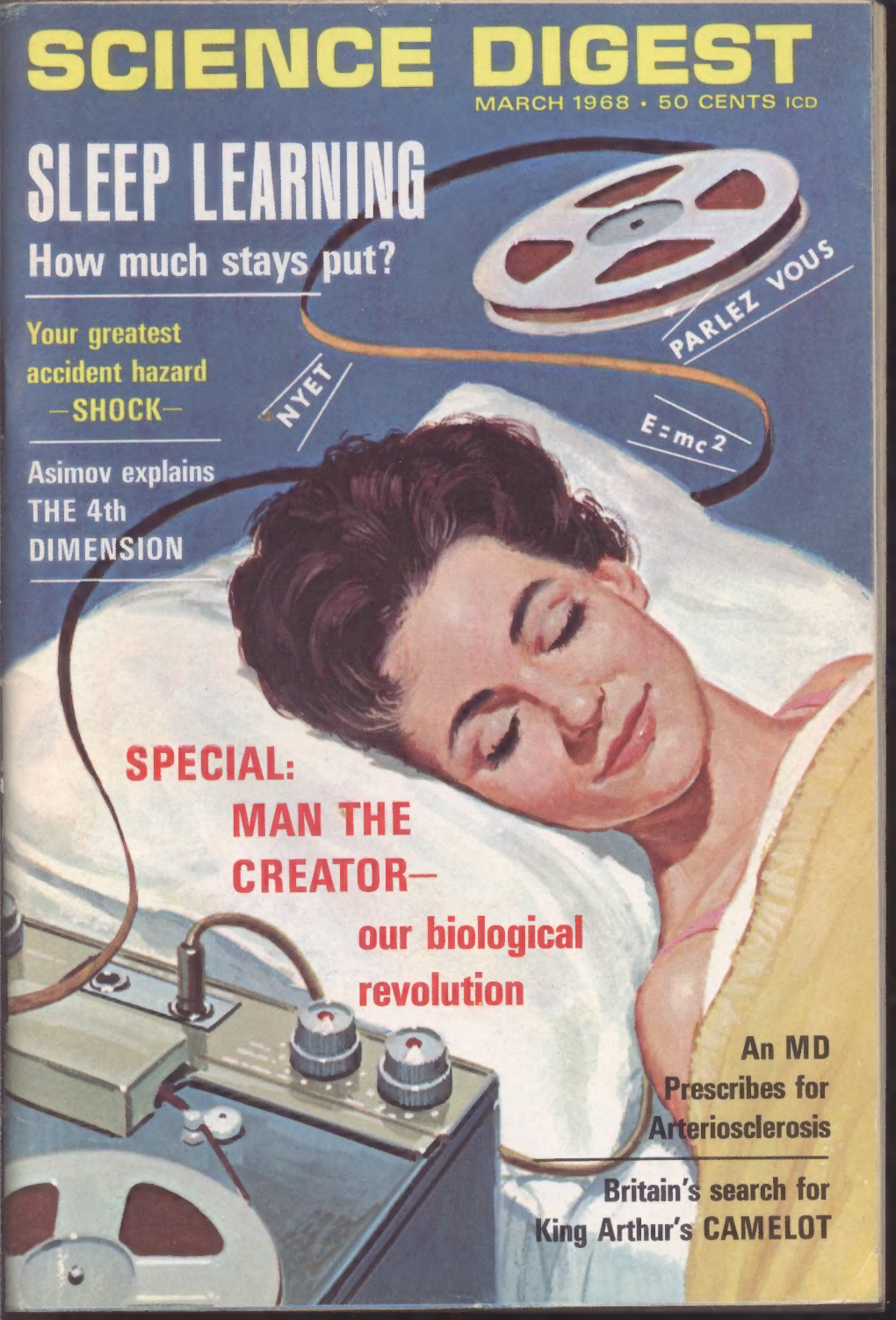

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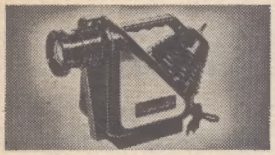

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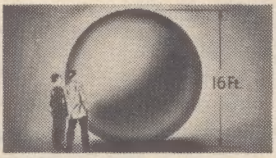

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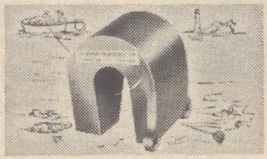

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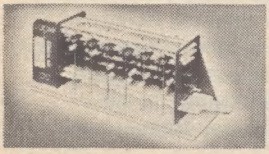

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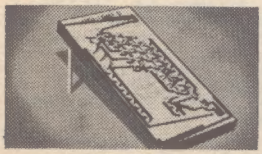

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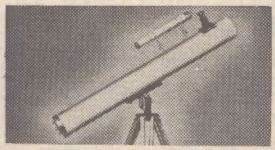

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BRUCE Frisch, one of our contributing editors and author of *Man the Creator,* our "special" for this month (page 43), was telling us the other day about some of the interesting things that happened during his research.

"All of the doctors involved in the creation of the recently publicized virus-like microsphere," he says, "were wary of me and the things I might say. They are scared that people will seize any kind of publicity and extrapolate for themselves. One researcher refused to let me take pictures and bade me farewell almost before our interview began."

THIS MONTH

The creation of life would be man's ultimate achievement. With so much at stake—and people being people—it's not surprising that these scientists are leery of misinterpretation. But it's hard for them to constrain their excitement. No wonder. One doctor has admitted the possibility of creating a man-ape cross; another has confirmed the possibility of combining early ovum eggs of different subspecies. It's exciting, all right, and Bruce Frisch has produced a great report on the subject. Don't skip it.

For anyone with qualms, Bruce points out that there's little point in being squeamish. "Scientists have already stated," he says, " 'Whatever's possible *will* be done'. And it will." —*RFD*

news, knowledge, advice

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DIGEST

Can you learn French or mathematics by having the lessons repeated over and over while you sleep? Will pep talks about the evils of smoking played through an under-the-pillow speaker help you kick the habit when you wake up? See what science has discovered about sleep learning. Page 7.

MARCH • 1968 Vol. 63, No. 3

CONTENTS

SCIENCE NEWS

Bulletins at Press Time 4
New for People 20
Science Month 27
New for Industry 62

ARCHAEOLOGY

Are These the Walls of Camelot? 32

BIOLOGY

Bugging the Beasts and Birds 14
SPECIAL: Man the Creator 43

DENTISTRY

Don't Grind Your Teeth Away 40

ICTHYOLOGY

Killers of the Deep 38

INVENTIONS

The Talking Computer 89

MEDICINE

I Prescribe for Arteriosclerosis 57
The Wonder Pill That Does Nothing .74

PHYSIOLOGY

Shock—Your Greatest Accident Hazard 22

PSYCHIATRY

Psychiatry Looks at Love, Smoking and the Common Cold ...67

PSYCHOLOGY

Sleep Learning 7

TECHNOLOGY

Student Design Awards 64

ZOOLOGY

This Is an Extinct Animal 19
A Dog's Best Friend 66
Opossum: A Genuine Fraud 79

DEPARTMENTS

This Month 2
Colleges in Action 71
Isaac Asimov Explains 80
Quiz 83
Books 86
Letters 94

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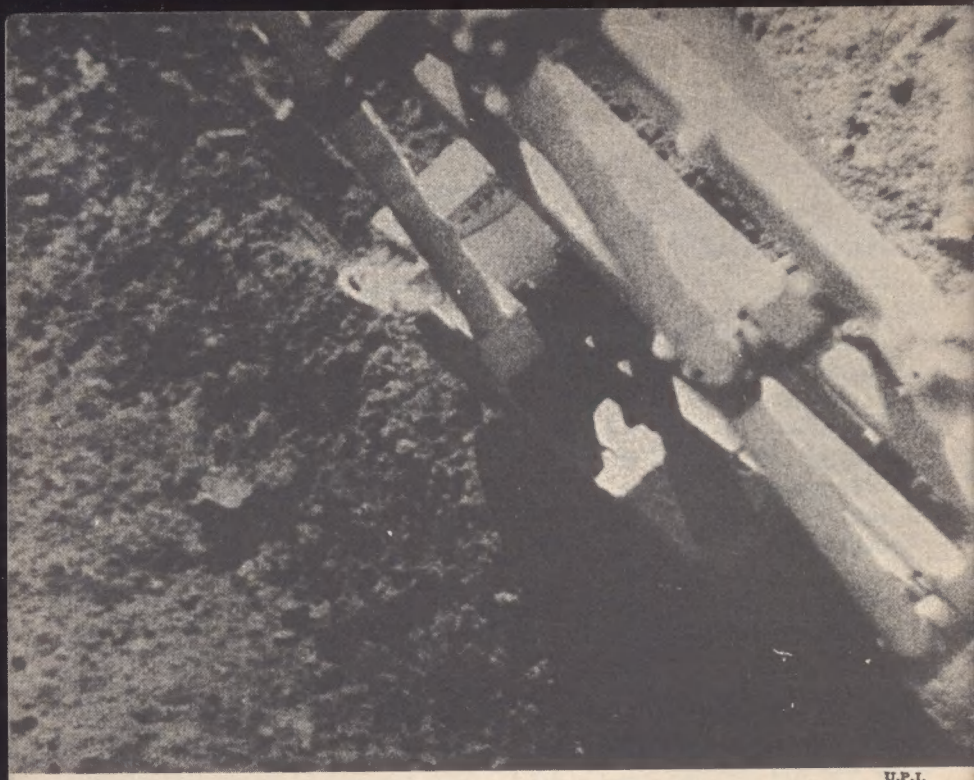

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NEWS IN BRIEF

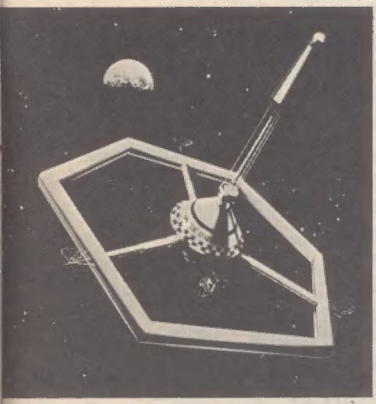
Bulletins at press time

LAST SURVEYOR. The Surveyor spacecraft program ended in triumph when the last craft in the series, beat the odds and landed successfully on a very rugged portion of the moon's surface. Surveyor 7 was soon able to send back pictures of its own arm scooping up lunar material (above).

MOST LIKE MARS. NASA is studying the microbes in the dry valley's of Antarctica in an attempt to learn how to detect life on Mars. Although the dry valleys are not exactly like Mars, they are the most desolate spots on earth. These valley's don't even have snow, and for years scientists believed they were devoid of life. But they have now found that for the four weeks of the year when the sun never sets in Antarctica, a host of tiny organisms spring to life in the valleys.

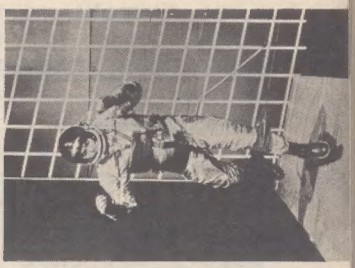
Is yours the special kind of mind that has to know . . .

. . . what happened to the master builders who created great civilizations, then vanished forever without trace, leaving elaborate cities and cultures crumbling in the jungles.



. . . what it will take in equipment, knowledge and human capability to send men on deep space voyages to the outer planets and beyond —and when we'll be able to do it.

. . . what limits of physical endurance the human body can survive—floating in gravity-free space, stretched to the limit in exhaustion, vibration, thirst, starvation.



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TO PRESERVE THE PAST. A new liquid formula to preserve ancient rock is being tested on 800-year-old stone churches in Ethiopia. The material was developed at the Conservation Center of the New York University Institute of Fine Arts. It has passed preliminary tests but the Ethiopian experiment is the first full-scale field trial. The deterioration of artistically or historically important outdoor stone works has always been a problem, but the problem has become much worse in recent years because of air pollution. The origin of the ancient Ethiopian churches is unknown but they are still used.

FERTILIZER HAZARD. Biologist Barry Commoner has warned that growing use of inorganic fertilizer is creating a serious health hazard particularly for infants. Dr. Commoner noted that the nitrates in the fertilizer can become concentrated in foodstuffs, including certain baby foods. These nitrates react with intestinal bacteria in such a way that they can, sufficiently concentrated, lead to respiratory failure and even death. Infants he noted are particularly susceptible due to the nature of the bacteria.

UNKNOWN ENERGY. Two astronomical puzzles, the strange radio emissions attributed to "mysterium" and the extremely intense infrared objects, that have been discovered recently, may really be the same class object. The big problem remains, however--what are they? These objects which seem to lie within our galaxy seem to be generating far more energy than considered possible for a star. Astronomers speculating on possible sources for this energy advance three theories:1. They are new stars being formed. 2. They are stars undergoing disruptions of a kind never before observed. 3. They are the creations of distant supercivilizations. Such supercivilizations were postulated in 1960 by Dr. Freeman J. Dyson of the Institute for Advanced Study in Princeton, N.J.

Can our sleeping brain absorb information from a recorded message? Is it possible to change a habit or an entire personality? What is the truth in the promise of . . .

Sleep learning

To the overworked student, drowning in a flood of unlearned lessons; to the nervous smoker, trying desperately to kick the habit; to the housewife, who would like to learn French in her spare time, but just can't get the "knack"; to all of us, who would like to learn to do something or not to do something easily—the promise of sleep learning is like a promise of utopia. In this utopia all sorts of hard things would be absorbed subconsciously without taking up any of our time or effort.

Supporters and promoters of sleep learning hint at, although they do not actually promise such wonders. The almost miraculous powers of sleep learning are supported by a flock of testimonials from television and motion picture celebrities. The most spectacular of these claims concerns TV and radio personality Art Linkletter. The book, "Sleep and Learn," by David Curtis calls this case, "Perhaps the most impressive example of the retentive powers of the subsconscious during sleep is that of Art Linkletter . . . In full view of the millions who watch his program, Linkletter offered to test the theory by attempting to sleep learn the most difficult language in the world—Mandarin Chinese."

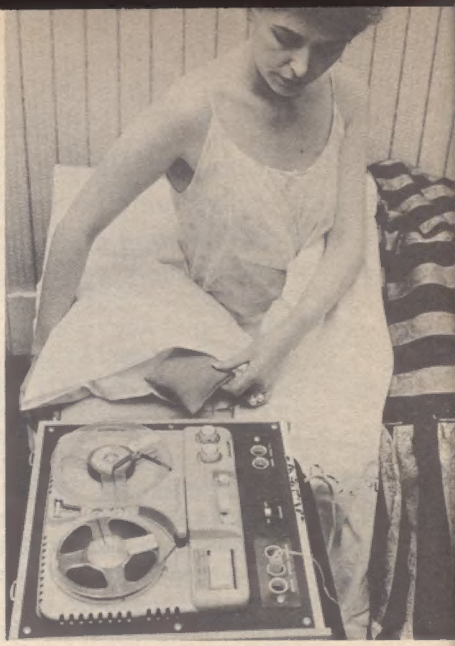
After a mere 10 nights, reports Curtis, Linkletter was able to converse in Chinese with the vice counsul of China on his TV show.

Scientists, however, while openminded, are considerably less enthusiastic about sleep learning as a golden gate to painless training. Many are skeptical about man's ability to learn during deep sleep.

Sleep was once believed to be a state of psychological inactivity, broken only by an occasional dream, but basically as much of a period of rest for the mind as it is for the muscles. Today we know differently. Instead of being a state of unconsciousness, sleep is a state of altered consciousness. The dream is not a disruptive freak in a good night's sleep. We all dream regularly every night, and moreover, dreaming is absolutely essential to our physical and mental well-being.

Nor is the sleeper entirely cut off from the stimulus of the outside world. In one experiment, a sleeping subject was sprayed with a light

(Text continued on page 10)



Typical of many sleep learning courses is the one offered by Geoffrey Stocker of London. Basic tools of the course are a tape recorder attached to a time switch which turns the recorder on two hours after the subject is asleep. Stocker believes that, "During sleep the subconscious mind is accessible and suggestible." Progress of "lesson" is shown at right. Subject places padded speaker in her pillow, switches on timer, then after she is deeply asleep the lesson is broadcast.

All the lesson tapes are pre-recorded by an expert in the subject. Stocker says the sleep learning method is particularly suited to the study of foreign languages, but that many other subjects, from driving to archaeology and mathematics, have been taught.

Lessons are transferred to other tapes which have a pre-recorded "conditioning message." These are gentle soothing words that play for the first 10 minutes to prepare the student for the information.

shower of water. He did not waken, but later reported dreaming of being caught in a rainstorm. And how many of us have had the experience of dreaming of a terrible noise that grows louder and louder until it finally shocks us into the waking world, where we realize it is our alarm clock.

Thus sleep learning is based on the established facts that the sleeping brain is active and that the sleeper can receive messages from the outside world.

Does it work?

In practice, sleep learning seems simple enough. A recorded lesson is broadcast over and over again through a speaker under the sleeper's pillow. In theory, your brain should absorb some of what is being said without your being aware of it. Proponents of this sleep learning technique claim it is suitable for teaching the content of ordinary academic subjects and is especially effective in implanting suggestions that will influence the attitude and behavior of the sleeping student.

That's the theory; now, does it work? For a subject that has long attracted a great deal of public interest, there has been surprisingly little experimental work done on sleep learning. Perhaps the largest experiment ever took place in the Soviet Union a little over a year ago. One thousand residents of the atomic research center in Dubna tried to learn English by radio in their sleep.

Supposedly, Dubna was chosen for the test because of the above average intellectual capacities of its residents. Most of them are associated with the Joint Institute of Nuclear Research. Dubna is a town of 20,000, about 70 miles north of Moscow, on the Volga River.

The evening lesson began after an interlude of light music intended to lull the student to sleep, or at least induce drowsiness. The students, ranging in age from 18 to 50, were supposed to be in bed by 10:30. Experiments at the Ukranian Academy of Sciences in Kiev, which has been trying to develop the method in the Soviet Union, found that the most effective teaching period is in the 15 to 30 minutes before the student falls asleep, and in the state of superficial sleep for the twenty or thirty minutes that follow. For good measure, in the Dubna experiment, the lesson was repeated during the early morning hours, before the subjects were fully awake.

There was nothing revolutionary about the methods used in the Russian test. But it was the first time that such tests were conducted by radio on such a large scale. What were the results? Like so many of these tests which are announced in a blaze of publicity, then seem to fade to nothingness, the results have never been made public. Checks of the Soviet Information Bureau at the United Nations, the Soviet News Agency Tass, and the U. S. news agency which filed the original story,

Some tests have shown that no information can be imprinted on the brain of a deeply sleeping subject.

turned up only dead ends. No one knew anything. No one had ever heard more about the tests. It seemed almost as if the original story was simply a whim of a writer's imagination. Perhaps it was.

Even if the Soviet test had been a rousing success, it would still leave many of the criticisms of sleep learning unanswered. The Soviet test concentrated on the times when the subject was just dropping off to sleep or just waking up. American tests indicate that information cannot be picked up by a person who is sleeping deeply.

Some years ago, Dr. Charles W. Simon, then at the Rand Corporation in Santa Monica, Calif., conducted what were considered a definitive series of tests on sleep learning. His studies demonstrated that information absorbed by a person grows less and less in the progression from alert wakefulness through drowsiness into a state of deep sleep. According to the tests, no information is learned or imprinted on the brain during deep sleep. Dr. Simon emphasized that he had done everything to bias the experiments toward sleep learning by selecting very intelligent subjects and playing extremely simple lessons over and over again.

However, the psychologist conceded that if the Russian experiment did take place, the subjects may have benefited from increased exposure to material in the time before they fell asleep, and at intermittant periods of wakefulness during the night. These might combine to shorten normal wakeful learning time.

The intensely practical, and skeptical *Consumer's Bulletin* published a report on sleep learning in October 1960. The publication concluded that on the basis of available information, the sleep learning procedure could not be recommended as a practical and effective aid in gaining knowledge. The report noted that although learning could take place during periods of semi-wakefulness or light slumber, those are the times that mental acuity is at a low level. The listener is relatively incapable of comprehension, interpretation and logical organization of what he hears. Whatever learning might occur during these periods would necessarily be at a very low level of value.

The *Consumer's Bulletin* report concluded: "The double use of time — simultaneously for learning and for achieving the rest which man's minds and bodies require— is not worthy of serious attention by persons hungry for knowledge. Both purposes will be better achieved by studying while awake and alert, and by arranging for periods of sleep without the presence

of mentally or physically disturbing factors."

Claims have been made that sleep learning techniques can give you confidence, help you overcome nervous tension and break unwanted habits. Dr. Simon speaks out strongly against such a procedure: "Some persons who require this form of self-reinforcement may need more competent professional aid. Where records are used to stop a child from bed-wetting or nail-biting, it is only the removal of a symptom. It may actually do more harm than good. . ."

Not for habit breaking

There seems to be general agreement among most psychologists that to stop a child from a bad habit by suggestion — accomplished either through hypnosis or sleep learning—may be asking for serious trouble, because the child could develop even a worse habit as a consequence. The proper approach, according to the psychologists, would be to uncover the cause of the habit and treat that. A strong warning is sounded by both psychologists and psychiatrists against the use of suggestions to alter anyone's personality or habits without proper professional supervision.

Proponents of sleep learning often quote the old adage, "I'll sleep on it." They claim that many a person has gone to sleep with a problem on his mind and awakened in the morning with the solution. It is said that Thomas Edison was an advocate of sleeping on the problem. But is this really sleep "learning?" No information is being absorbed—the mind is merely working over information it has.

One of the strongest arguments, although an indirect one, in favor of sleep learning is based on the startling results obtained by Dr. Wilder Penfield of the Montreal Neurological Institute. During brain operations, Dr. Penfield discovered that by touching certain parts of the brain with a very weak electric current, the patients recited conversations, sang songs and said poems which they had not thought about in years and believed they had forgotten. It seems our brains act like tape recorders to store information. Even if we can't consciously recall something, the memory is still there, and the mental record can be replayed under the proper stimulus.

Unfortunately we don't know how long it takes to implant such memories, nor is there any proof that something dinned into your ears while you are asleep will become forever recorded in the natural recording machine of your brain. And even if it is recorded, what good will it do if it cannot be recalled on demand? Surely a person cannot have his brain operated on every time he wishes to remember a French lesson.

Sadly, the evidence supporting sleep learning as an easy road to knowledge, or a more satisfactory personality, is not very impressive. And there is some solid evidence

that sleep learning, as opposed to learning while drowsy and half-asleep, simply does not work. The bulk of responsible opinion is that the best method for learning is to study while awake, and then get a good undisturbed night's sleep.

But learning and memory are areas which, from a scientific point of view, are almost entirely unexplored. Sprinkle over this ignorance the always popular testimonials from TV personalities and add the ever present human desire to find the easy way to do a hard thing, and it is safe to assume that people will be hopefully putting microphones under their pillows for a long time to come. Maybe they will even learn something. Most sleep learning kits specify that the subject should record his own lessons. While doing the recording, a person may absorb the information and then think he did it during his sleep. In addition, what doctors call the "placebo effect" cannot be discounted. A placebo is an inert pill, but the patient who gets one thinks it is some form of medicine. Many patients take the placebo and get better. Thus if a subject thinks he has an easy learning method, the psychological lift he gets may help him overcome learning blocks, and he actually may learn better. The same sort of effect may take place for people trying to break the smoking habit. The feeling that they have some kind of "scientific" method helping stiffens their will power.

And finally, in fairness, it must be admitted that there is enough uncertainty in the field so that sleep learning, in some unknown way, actually may work for some people.

"And when did you first have this feeling that you were a 'nobody'?"

Bugging the beasts and birds

Man is on the way to solving the mysteries of wildlife activity, and he's doing so by tapping the sources with transmitting tracking devices that don't miss a move.

by Hank and Vera Bradshaw

SCIENTISTS are now putting bugs on animals and birds instead of removing them.

These are special "bugs," tiny transmitters that are part of a detective-style tracking system. Wildlife can thus be followed by radio day and night without being spooked.

Called wildlife telemetry, this system is letting experts in on secrets locked for ages deep in animal instinct. The knowledge gained is helping scientists save some endangered species, slow the spread of animal disease and plan better food-and-cover areas for wildlife.

But more important, experts are getting information that may help explain some mysteries of human behavior.

Scientists now know how many

WILDLIFE ACTIVITY KEY

DEER

1. At 1:30 a.m., deer in the midst of feeding.
2. Stops for a drink of water.
3. From 8:00 a.m. to 3:30 p.m. stays close to resting area.
4. Starts night rounds again.
5. Finishes 24-hour tour which has taken deer around a mile-square area.

RABBIT

1. Feeds in open at night.
2. Escapes to heavy area when threatened.
3. Can cover range in 3 or 4 hours while feeding.

PHEASANT

1. Roosts in higher elevations at night.
2. Feeds in open grain fields.

BEAR

1. A bear instinctively knows of approaching snowstorm that will cover his tracks leading to his winter hibernation den.

deer stocked into a strange area are likely to be killed during the first hunting season. They know how often a raccoon changes dens; where a grizzly bear spends the winter; and, astonishingly, how rapidly a baboon's heart beats when he's fighting.

Very few species have missed being bugged. And in Virginia, scientists hope to install telemetry devices within the air space of a mallard duck egg to determine the effects of parental care.

In this case, the transmitters will be planted internally—one of two bugging methods. In other cases, transmitters are attached to wildlife externally.

The external system consists of attaching a tiny transmitter with either loop or whip antenna to a collar which is put around the animal's neck. For a bird, the transmitter is strapped to its back. These transmitters send out continual beeps. The signals are received through antenna either installed in permanent towers, attached to trucks or shielded in hand-carried equipment used by listeners on foot.

Each bugged subject is given a different-sounding beep or a different frequency, so several can be tracked at once from the same stations. Bugged wildlife can be "shadowed" within 20 miles of the receiver.

The internal system operates the same except that *physiological* sensors are attached to transmitters and implanted surgically inside the animals.

But the wild creature must be

Reprinted with permission from Popular Mechanics © 1967 The Hearst Corp.

caught before it can be bugged. And then it must be caught again to remove the expensive equipment. Experts trap animals, net birds and shoot larger wildlife with anesthetizing guns.

So once an animal is bugged, its movements, needs and habits are recorded. Knowing where rats go at night, for example, can be important in tracking down sources of human diseases.

Telemetry is getting so sophisticated that experts can even detect the erratic flight of a sick bird. Actually, scientists in Montana have learned to recognize the spasms of a "bugged" blue grouse suddenly poisoned by insecticides.

To get the real feel of wildlife telemetry, we sat all night in a truck tracking five cottontail rabbits. Dr. Jim Bailey of the University of Illinois showed us how the equipment in his aerial-equipped truck worked. He'd been tracking these rabbits for five months. All the rabbits were wearing loop antennas on transmitter-bearing collars. A few hundred yards away, his assistant, Jeff Hanson, sat in another "wired" truck. They talked by radio as they mapped the rabbits' movements.

"Since rabbits are the most universally hunted game," Jim said, "conservation commissions want to know what type of areas can support more rabbits."

Of deep concern to all state game commissions are hunters. They buy the licenses that supply the money for conservation and game control. Take South Dakota. It is studying deer migrations between winter and summer ranges so hunting seasons can be regulated correctly. Russell Robbins, state biologist, tells about one mule-deer buck he radio-tagged during part of the study. For nine days, this monitored buck outmaneuvered hunters, although, according to a telemetry "fix," he once stood only 40 yards away. Frequently, this buck watched hunters, unnoticed, from less than 200 yards, despite a blaze orange cloth around his neck. And, these same hunters proclaimed that the country was devoid of deer.

G. Gene Montgomery and Robert E. Hawkins, of the Illinois Natural History Survey, have uncovered surprising data on stocked and native deer. They radio-tracked 76 deer in Illinois using two permanent antenna towers. Results show that it is unlikely that diseases are passed between stocked and native deer. They avoided each other. They used the same watering and feeding places, but at least eight hours apart.

The two experts learned that transplanted deer seemed unable to elude hunters. In 1965, all transplants were killed during hunting season (despite being given months to learn the territory), while only 40 percent of the native deer were killed. In 1966, results were similar.

In another study, Dr. John Tester, of Minnesota's Museum of Natural History, has learned that deer continually change beds, two

to four times during daylight hours, four to five times at night.

The electronic third degree of telemetry is continually producing surprising facts. Minnesota scientists have found that as the snowshoe hare feeds, it covers its entire home in three to four hours. And transplanted hares are likely to return to their home ranges. In probing the raccoon's habits, it was learned that unless feeding young, they change den trees nightly.

In Louisiana, by means of changes in transmission signals, scientists can tell whether alligators are sunning on land, floating on the surface or swimming underwater. Ontario has proven — disproving an old theory—that timber wolves, after being handled by man and released, will be accepted by their hunting packs. Manitoba has determined when polar bears leave Arctic ice wastelands and move inland. South Dakota is determining the general movements of individual wild turkeys between flocks.

And two famous telemetry experts, John and Frank Craighead, of the University of Montana, are tackling the most ticklish study of all—grizzly bears. Their results are surprising.

By actually radio-tracking grizzlies to their dens on the day hibernation began, they learned that by some sixth sense, bears wait for heavy, blowing, drifting snow that will unfailingly lock their dens for winter. The snow covers their tracks as, all at once, they hurry to

Transmitter (below) with antenna and battery weighs just over 1/10 ounce. It was designed by Bill Cochran of the University of Illinois for use with animals. Rabbit has collar-mounted transmitter equipped with its own batteries and whip (shown) or loop antenna. Birds have transmitters attached to them so that their seasonal migrations can be tracked.

their widely separated and previously bedded dens. Always, these dens are on the north side of slopes immune to winter's thaws and secreted beneath the roots of a large tree. Inside, as with Eskimo igloos, the sleeping chamber is raised above the opening so warmth will be trapped. Currently, the Craigheads are planning to count heartbeats and take electrocardiograms by external transmitters, and also to insert thermistors into the bodies of grizzlies in order to record body temperatures.

It is to such internal telemetry systems, rather than to external systems beneficial to wildlife scientists, that medical men are looking for the answers to giving man a healthier and better life. By embedding sensors in free-roaming animals, such as pigs and wild baboons, whose circulatory systems resemble humans', physiological reactions are being studied. Conceivably, medical science may learn what causes altitude sickness and hypertension, gain understanding of why the heart performs as it does under stress and find answers to other medical enigmas.

At Colorado State University, Dr. Harry A. Gorman is studying mule-deer and swine in an attempt to forecast and predict the effects of sharp altitude changes on humans. Although it doesn't seem flattering, the physiological makeup of swine compares favorably with that of humans. Dr. Gorman designed the sensors used on animals sent into space in the early earth-orbiting bio-satellites.

"Both swine and deer are affected when taken quickly from our campus altitude of 5,000 feet up to 10,000 feet," Dr. Gorman said. "But deer seem to take the change in stride and adjust rapidly. Swine, on the other hand, become lethargic, like humans, probably have headaches and, if they exercised much, would develop serious heart and lung problems."

Another internal study is being made by Dr. Robert L. Van Citters, associate professor of physiology and biophysics at the University of Washington, Seattle. Dr. Van Citters "bugged" baboons in Africa because their cardiovascular responses are probably much more akin to man's than those of usual laboratory animals.

"We are now analyzing the data, hopeful it will lead to an understanding of how the human heart performs under stress, and more important, why it does so."

Added to this experiment was another feat. Buried surgically in the baboons was a device which, on signal, anesthetized them. Then the scientists walked in to recover their transmitter packs, each valued at $5,000.

Most scientists agree that it will be about 10 years before wide-scale definitive applications can be made of most of the work which has been started. "All life has a lot of common denominators," said Dr. Sanderson, head of the Natural History Survey, "and we are trying to learn more about them."

This is an extinct animal

PLANA Cay, an island in the Bahamas about one square mile in area, has something no other place in the world has—hutias—and plenty of them, too—from five to eight thousand. After dark you can stand on the beach and see hutias (and not much else) everywhere on the uninhabited, semi-arid bit of land.

If you haven't heard of the hutia (hoot-i-a), it's understandable. Not much is known about the smallish (slightly over a pound), furry rodents that look like muskrats but are more closely related to the porcupine, the guinea pig and the nutria. In fact, two authoritative scientific books recently called this particular species of hutia "extinct."

To fill the information gap about hutias, Dr. Garrett Clough, an assistant professor of zoology at the University of Rhode Island, applied for a National Science Foundation grant to study the creature. He is now directing a NSF project at the university to amass data on the behavior, age and distribution of hutias. Other facets of the program are being handled at the University of Puget Sound in Tacoma, Wash.

On Dr. Garrett's last trip to Plana Cay, he brought 10 live hutias, six males and four females, back to Rhode Island.

"One of my females just had a litter of one," he said. "That's the usual number of young.

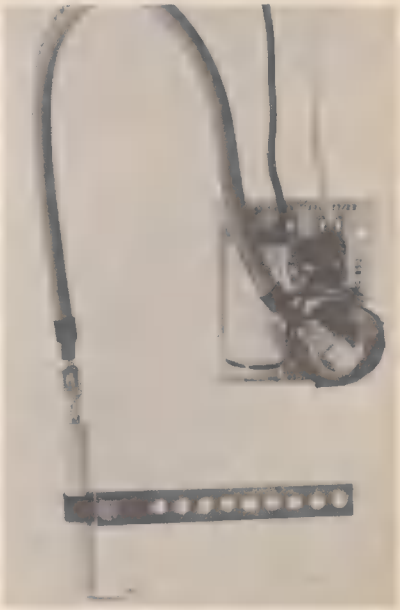
"The hutia has taken the opposite tack from the lemming," he added. "Lemmings are very aggressive and have a high reproductive rate. But hutias are very tame and have tiny litters. They live in peace with each other. Human beings could learn a lot from the hutia."

Hutias aren't very big, but they're the biggest creature on Plana Cay, Dr. Garrett says. Birds, lizards and bats are the only other animals that find the barren island to their liking. The hutias eat the leaves and bark of a small bush that grows on the island. But they're not finicky eaters. At the laboratory, they relish sweet potatoes and maple branches.

"Yes, they'd make good pets, but I don't think the Bahaman government will let any more of them out," Dr. Clough says. "So they'll never replace the gerbil."

The modern and safe way to learn to drive —sitting in a simulated car watching the road go by on a movie screen, and being taught by an instructor and a computer. By Ratheon Company, Lexington, Massachusetts, for Aetna Drivotrainer System.

Spark ignition system, below, relights gas appliance pilot burner should it go out. Sparks occur from electrode to ground until pilot flame appears; then spark turns itself off. It resumes if flame dies. Fenwal Inc., 400 Main, Ashland, Mass.



No longer are needle and thread necessary for dress repairs. With the rage of paper fashions, a tape and dispenser, Zip. N. Klip., left, is the quick way to make repairs. By Unipat Corporation of America, 135 S. LaSalle St., Chicago, Ill. 60603.

Computer Age has invaded Indian territory. The Navajos of Window Rock, Ariz., have installed an IBM System/360 Model 20 to perform more than 125 jobs—from maintaining inventory of reservation livestock to running analyses of tribe's oil leases.

Even rain won't put a damper on this waterproof permanent match. Strike the metal match against flint side of box it comes in and have a light every time. One lighter fluid filling lasts weeks; match is guaranteed to last years. Ginio's and Son Co., 1403 Faye Ave., Spring Lake, N.C.

A removable, padded plastic shield called a tot-guard has been designed to increase collision safety for children. It can be used in any seating position of a car with a conventional lap belt. By Ford Motor Co., 20000 Rotunda Dr., Dearborn, Mich.

Keystone

The cigarette case for the smoker who wants to try to limit himself to a certain number of cigarettes per so many minutes comes from the famous clock makers—the Swiss. The case has a clock to control its opening according to smoker's needs.

Shock— your greatest accident hazard

Nature uses shock to stop bleeding or, if the wound is too grave, to give a painless death— even though grave wounds can now be healed.

by Fred Warshofsky

EVERYONE who has taken a first-aid course can provide a description of shock. The victim is pale, his skin feels cold and clammy, his pulse is fast and weak and his blood pressure is dropping sharply. They can also tell you how to treat shock: Put the victim's head down and his feet up and thus use gravity to raise the blood pressure and increase circulation to the brain. This is the so-called Trendelenberg position, routine in the treatment of shock not only as a first-aid measure, but as part of hospital therapy since World War I.

This treatment is not only useless; it is often harmful. For the shock victim, the best first aid is almost always no treatment at all, aside from keeping him warm and stopping the bleeding.

This startling information is the result of studies by the University

of Southern California Shock Research Unit, one of several groups beginning to unravel the mysteries of shock that make it one of medicine's most baffling killers.

"Serious shock," says Dr. Max Harry Weil, chief of the USC shock unit, "has a mortality of 70 to 85 percent."

What is there about shock that makes it so difficult to treat? Shock is not a disease; nor is it technically an injury. Shock is a reaction to injury or illness, one of the most primitive and drastic of which the body is capable. Under conditions of stress, massive amounts of a chemical known as epinephrine pour from the adrenal glands into the blood stream, where it rapidly swirls into the sympathetic nervous system—that part of the body's command network that carries on automatic functions such as breathing and blood flow. Respiration races, the heart beats at a furious pace, pumping oxygen into the blood to supply the demands of the muscles. At the same time, commands go out to the sphincters or muscular valves that control the size of blood vessels, ordering them to clamp down throughout the circulatory system as a sort of built-in tourniquet to prevent excess bleeding in the event of a wound.

Nature designed this system to cope with minor wounds, those which needed a tourniquet only until the body's slow process of clotting had staunched the flow of blood and allowed it to be pumped with safety once again. For those grievously wounded, beyond the body's own natural power to heal itself, shock meant a painless death. But now, man has the power to reverse the effects of what were once mortal injuries. Yet nature recognizes only her own evolutionary designs and keeps the blood vessels shut down and death results.

Shock is the killing complication in a great number of what are frequently no longer fatal conditions. An auto accident victim, even with his arm sheared off, can not only be prevented from bleeding to death, but might also have the arm sewn back on, or reimplanted and recover its use, if quick action is taken. But more often than not, the victim's own body betrays him. At the first indication that there will be a massive blood loss, hemorrhagic shock takes over. This, the most frequently encountered form of shock, occurs when the volume of blood flowing through the body is insufficient to nourish all the organs vital to life. And there are several other equally deadly forms. Massive burns are a major invitation to shock. In this case, the volume of blood available stays constant, but the total area that must be supplied expands greatly. Burned tissues swell to many times their normal size and soak up fluids from the blood and from healthy tissues. The blood cells themselves stay in the blood stream, but the loss of the fluid portion of the blood, the plasma, decreases blood volume.

Shock often follows a heart attack. Experts estimate that as many

as 19 percent of the 528,000 American deaths attributed to heart attacks each year would not have occurred if shock had not set in. For when the great muscle suddenly stops beating, the arteries and veins swiftly constrict in an attempt to counteract the sudden fall in blood pressure. This forces the still blood-laden veins to eject their contents into the heart with great force, overloading an already weakened pump and making it extremely difficult for it to resume its vital beating. Drugs which stimulate heart action and raise the blood pressure save 40 percent of cardiogenic shock patients.

Bacterial shock

A common cause of shock is the production by infectious bacteria of endotoxins or poisons that give the arteries and veins false orders to shut down. "Bacterial shock is an extremely grave clinical event," says Dr. Weil. "Mortality is very high—80 percent in some series studied in hospitals such as ours."

For the pregnant woman shock is a lethal concomitant possibility to delivery—accounting for almost half of all obstetric deaths. Even when the obstetric patient survives shock, its aftereffects can cause death.

Shock can also manifest itself in the form of a bizarre allergic reaction to some substance. This relatively rare type is known as anaphylactic shock when the body, already sensitized to a given drug or chemical, reacts to a second dose with a violent shutdown of the blood vessels.

Progress is being made against all these forms, primarily in a handful of special shock centers which use sophisticated monitoring equipment to draw an accurate picture of the patient's ability to stay alive.

This type of intensive treatment of shock has proved most effective, as can be seen at Walter Reed Army Medical Center in Washington, D. C. Says Col. Robert M. Hardaway III, M.D., director of the division of surgery, "The survival rate in serious shock is normally about 36 percent. In our shock unit, approximately twice as many survive."

Such dramatic reversals of the shock mortality statistics can only come from better understanding of the shock mechanism. One of the best examples of this is seen in the simple but important abandonment of the Trendelenberg position. In an article published in the medical journal *Surgery, Gynecology and Obstetrics,* Dr. Weil advises that.

Working with anesthesiologist Dr. James Taylor, and the USC unit's chief physiologist, Howard Whigham, Dr. Weil first experimented with rats which had been put into mild shock. When kept in a horizontal position, no rats died. But rats placed head-up had a 50 percent rate, and those placed in the head-down (Trendelenberg) position had a mortality rate of 89 percent. The reason, monitoring

Studies show that famous Trendelenberg position, feet up and head down, is harmful to shock victim.

equipment showed, was that in the head-down position the abdominal organs pressed against the diaphragm, impeding breathing, while the flow of blood to the brain, increased by gravity, exerted a pressure that prevented the brain's control of circulation and respiration.

The next step was to see if the same results could be obtained on human patients whose primary injury or illness had been arrested but whose lives were still threatened by shock. One group of such patients was placed in the Trendelenberg position; a second group remained horizontal. The results were impressive. Six of the seven patients placed head-down suffered a marked drop in blood pressure. (The computer enabled the doctors to determine the exact point at which to restore the patients to the horizontal to avoid any permanent bad effects.) Of the group in the horizontal position, blood pressure either remained the same or increased. Most exciting was the discovery that the cardiac index, a measure of the efficiency of blood circulation, of the patients placed in the horizontal position increased by an average of 50 percent over the group in the Trendelenberg position.

Shock research has also come up with a better means of replacing fluids in a blood-starved body. In hemorrhagic shock, for example, standard treatment has been to pour blood plasma into the victim to replace lost blood. But too often the sudden infusion of plasma caused congestive heart failure because a circulatory system in shock, already choked at various points by stagnant pools of blood, is unable to move additional fluids to the tissues. The end result is an impossible addition of plasma into a heart that is no longer capable of pumping it out into the circulation.

But Dr. Weil's group has found that an intravenous glucose solution (sugar water) provides sufficient short-term nourishment for blood-starved tissues, since it passes much more rapidly through the cell walls than plasma. Thus it does not require the pumping action of the heart to move to its ultimate destination and congestive heart failure is avoided.

One of the most promising avenues of shock treatment came from the discovery that during bacterial shock the body itself puts out excessive amounts of corticosteroids, a hormone produced by the outer layers of the adrenal and other glands. Why not administer large doses of corticosteroids to those in shock? Two years ago, in one of the first clinical studies of this treatment, Dr. Philip Marcus, of Boston City Hospital, found that in one group of 48 shock patients treated with corticosteroids, none died dur-

ing the first 24 hours. By contrast, six deaths were recorded in a control group during the same period. The overall mortality rate, however, was the same for both groups—33 percent. But each hour gained increases the chances of surviving shock. Noting this, Dr. Marcus said that, "continued corticosteroid therapy beyond the initial treatment, in our belief, could bring about an increase in the eventual survival rate."

The emphasis on drug therapy has also led to a concept almost as revolutionary as the abandonment of the Trendelenberg position. With blood pressure low, it has been standard practice to use chemical agents that constrict already narrow vessels, thus increasing their resistance to blood flow and thereby raising the pressure. With the chemical clamp on the vessels, however, less blood goes back to the heart. Eventually the constriction of the vessels leaves virtually no blood for the heart to pump and the patient enters a stage known as irreversible shock, where death is inevitable.

So several researchers decided to try instead drugs that would dilate, or open up the blood vessels. This resulted in even lower pressures than the already low levels associated with shock, but when accompanied by the infusion of fluid such as glucose solutions, to increase the blood volume, it allowed more blood to circulate throughout the body and to return to the heart. Today, these so-called vasodilating agents are being used more and more in the treatment of shock victims.

One of the new vasodilators, an experimental drug known as phenoxybenzamine, has come under intensive scrutiny by a group of University of Minnesota scientists headed by Dr. Richard C. Lillehei. Its real potential may lie in another new approach to shock: pretreatment of those patients most likely to go into shock—the victims of heart attacks, surgical patients, burn cases and others. Used on high risk patients in advance of shock, phenoxybenzamine appears to confer a sort of immunity to shock, making the body incapable of responding to the automatic orders to shut down arteries and veins.

Still another approach to pretreatment has been to use epinephrine itself, the chemical that orders the vascular shutdown to immunize the patient against shock. Graduated doses of epinephrine have rendered dogs immune to shock. Clinical trials of this technique on patients are planned.

Eventually, shock, like other natural body defenses that have been outmoded by man's growing control over his own destiny, may be conquered. "When all the mysteries of shock have finally been dispelled," says Dr. Weil, "we will have all the answers we need to save rather than lose 85 percent of the shock patients." Then, the growing list of modern medical miracles can save lives threatened by disease and injury without the tragic and blind reaction of shock that kills when there is no longer a reason to die.

The strange, cratered surface of the moon is shown here as seen from NASA's Surveyor VI under early morning light. This view of the lunar surface, taken a few months ago, is just southeast of the orbiting satellite, with the sun about 4° above the eastern horizon.

Science Month

Tomorrow's take-apart city

THE city of the future may have individual pods for people to ride in (but no cars as such), and buildings designed to last only 20 or 30 years. Air pollution would not exist and food would be delivered by pneumatic tubes.

A dream? Three federal departments and a number of industries have already donated $300,000 to a "city-of-tomorrow" study project. But four billion dollars will be needed to build just one such city.

Dr. Athelstan Spilhaus, president of the Franklin Institute of Philadelphia, described plans for the city in a meeting of the American Association for the Advancement of Science in New York recently.

According to Dr. Spilhaus, who became involved in the project when he was dean of the University of Minnesota's Institute of Technology, the prototype city will be built in Minnesota at least 100 miles from any other urban center.

The underground facilities would be installed first according to a fixed level of population. Once erected, the town wouldn't get any bigger. Beyond the city limits you would enter directly into open country, where areas would be set aside for recreation and farming.

Traffic fumes, if any, would be kept underground. A venting system would draw all smoke and fumes to a "scrubbing" plant that would purify the air. Sewage and other waste would be removed in

semiliquid form and purified to recover some of the material.

One of the most interesting plans for the experimental city calls for a system of public transportation with "personal pods" that would carry residents from their homes to work, recreation or marketing. The pods might run on a rail system.

Building materials would be stored underground and hauled to construction sites underground, at least in part. Designed for a 20 or 30-year lifetime, the buildings would be disassembled and taken underground when their tenure was up.

Dr. Spilhaus describes the model city as a "semiprivate" enterprise that might be under contract to the government. To finance the project, he urges that construction loans by the Federal Housing Administration be given to entire cities. Individuals or industries could also invest in them.

Present urban renewal is building the slums of the future, he added. The money might better be spent to relieve some of the congestion of overgrown urban centers.

Instant police check

Ohio policemen will soon be able to find out before they approach a vehicle if it is stolen or has been involved in a serious crime.

To get the information, the law enforcement officer will radio the car's license number to a nearby communications center with direct access to a new computerized information system in the state capital at Columbus. Within seconds the computer answer will be radioed back to the policeman.

The quick check should greatly reduce the policeman's chances of being unprepared when he approaches a car driven by an armed or dangerous person, the Ohio State Highway Patrol says. It should also increase recoveries of stolen cars.

Drivers with suspended or revoked licenses (about 50,000 in Ohio annually) will also be revealed by the computer.

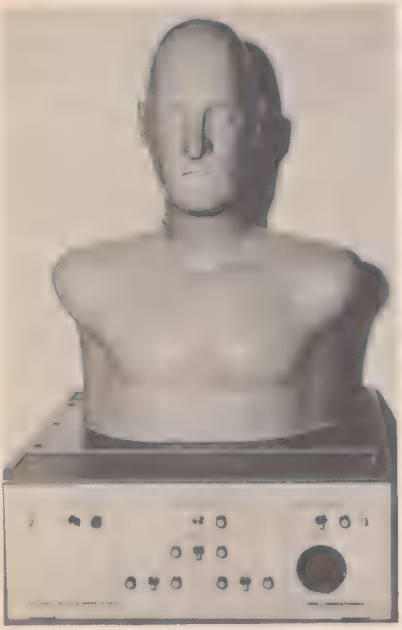
What makes the system work?

Called LEADS, for Law Enforcement Automated Data System, it consists of three IBM computers and information files at Columbus and 155 terminals scattered all over the state.

The files contain data on Ohio vehicles and operators as well as information on such things as stolen vehicles and missing license plates. A tie-in will connect the system with the FBI's National Crime Information Center in Washington.

"Use of computers in this manner on a state and national level probably represents the greatest advance in police information and communications since the radio," says Col. Robert M. Chiaramonte of the Ohio State Highway Patrol.

The system could result in saving Ohio citizens $274,000 a year



Ed, an electronic dummy, is a piece of test equipment in use at NASA's Manned Spacecraft Center in Houston. His ears are microphones mounted in the side of his head; his mouth, a miniature loudspeaker. He checks microphones and earphones.

just by increasing stolen car recovery by one percent, he points out.

Brainy birds; bird brains

We've heard about a crow who used to wait at ice holes where a fisherman had put down lines. When a signal flag went up to indicate a fish was hooked, the bird flew to the line, took it in his beak and walked backward to pull in a length of line. Holding the line down with his feet, he walked forward and grabbed more line. Eventually, he got the fish up to the surface where he could grab it.

An unusual feat for a crow? Not really. Crows and ravens, too, are the genuises of the bird world according to the National Geographic Society. Parrots, sparrows and titmice also show signs of unusual intelligence. But they are exceptions. Most birds have little learning ability compared to mammals.

Crows have learned to rouse their masters, call their names and go to the refrigerator for food. There are plenty of tales of crows' accomplishments. Scarecrows rarely scare them and the big black birds can even do simple arithmetic. If two men walk to a bird-watching blind and one leaves, most birds think both have left and resume their normal activities. Crows, however, seem to realize that one man has remained behind.

Ravens figure in other stories of bird intelligence. A pet raven that belonged to college students learned to pick pockets. Lighting on the shoulder of a visiting ornithologist one day, the bird poked its beak into the scientist's jacket pocket and took out a pencil. To the ornithologist's surprise, the raven carefully tested the pencil for edibility and then flung it scornfully to the ground.

But the majority of birds are authentic "bird brains." Owls, despite a reputation for wisdom, are remarkably stupid. Ornithologists

report that an owl flying around a laboratory will crash again and again into the same objects. One stupid owl insisted — for several seasons — on laying its eggs on the tin roof of a barn shed where they baked solid each summer.

Cat's eye for star-gazers

At Allegheny Observatory in Pennsylvania, star spectra so faint the human eye can't see them at all are being clearly recorded on a new "see in the dark" television camera developed by Westinghouse. The camera's sensitivity is at least 10 times that of photographic plates.

The tube responsible for the camera's performance converts the invisible light emitted by the star into an electronic signal and amplifies it hundreds of times before changing it back into a visible image. Even weaker light signals can be built up into bright images over a long period of time.

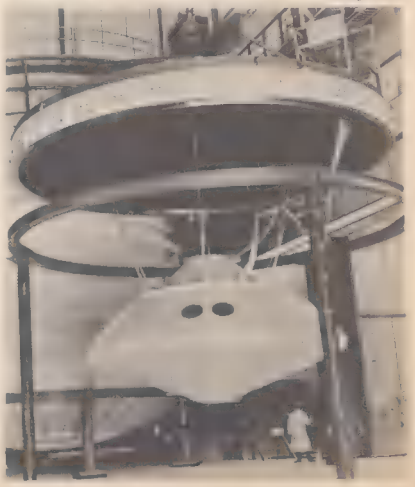
Here's how the process, called "integration," works. The camera is installed on the observatory's 30-inch refracting telescope. Bright visible images are recorded on film. Then the system is switched to "integration" for periods of 10 to 120 seconds. Less than a second after the integration period ends, the strengthened image appears on the television screen. A photograph of the image is made from the face of the television monitor.

In this way, faint astronomical objects can be recorded in just a minute or two instead of the half-hour needed for exposure on a photographic plate. A bonus is that the camera's red response is greater than that of photographic film, rendering the brightness of red stars and objects closer to reality.

The spectrum of a star that the new television camera records is a breakdown of the light the star emits and probably the most informative thing about it. It tells the star's temperature and chemical composition, identifies it as a giant or dwarf, indicates whether it has an atmosphere or a strong magnetic

SPECS, a prototype of spacecraft that one day may travel to other planets, is hoisted off its pedestal before being placed in vacuum at Martin Marietta Corp.'s Space Simulation Laboratory in Denver. Craft is subjected to hot and cold temperatures.

Keystone



field, estimates its age, provides insight into its past and future and pinpoints its position and motion.

New uranium boom

The day of the lone uranium prospector appears to be over. Or is it?

Back in the 1950s, a man with a geiger counter could strike it rich in uranium in the West. Before too many uranium millionaires were made, though, the boom was over.

Now the uranium boom is on again and it's bigger than ever. Commercial nuclear power has created a demand for the unstable element that is expected to outstrip the military needs of the past.

According to an item in the *Chicago Tribune*, the local Atomic Energy Commission office at Grand Junction, Colo., predicts that demand for uranium will grow to 38,000 tons by 1980. That's more than double the government's peak requirement in 1961.

But the increased demand isn't expected to affect the lone operator, the AEC says. Most of the obvious uranium reserves have been found. It will take expensive operations to find and mine new reserves. Already, renewed exploration is underway by several firms.

There's still some hope for the shoestring operator, though. The sparsely-populated uranium country, some of it still wilderness, will undoubtedly attract prospectors. A few fortunes may still be made.

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Are these the walls of Camelot?

In Southwest England archaeologists have found traces of an ancient fortress which some believe to be Camelot, home of King Arthur and his noble knights.

by Janet Graham

Is South Cadbury Hill, in Somerset, the site of King Arthur's legendary Camelot? Was Saint Swithin (the one who brings those wet spells) really buried outside the Cathedral at Winchester, so that "the sweet rain of heaven" would fall upon his grave? How did the Roman conquerors plan the elaborate gardens in the courtyard of their palace at Fishbourne in Sussex? What was the purpose, and the date, of the extraordinary 130-foot hill at Silbury, Wiltshire, the largest artificial mound in Europe? All over Britain, archaeologists have been digging to unravel these and other mysteries of the island's past.

The area around Cadbury Hill has been associated with the name of King Arthur ever since the 12th century monks of Glastonbury found themselves desperately short of funds to rebuild their Abbey after a fire. They needed publicity and public support—and by a piece of suspiciously good fortune, unearthed a "tomb" of King Arthur right there where they wanted it. Cadbury Hill, girdled by four impressive ramparts, lies only a dozen miles away. Quite soon after this monkish forgery, it was presumed to be the site of Arthur's palace.

The Camelot-Cadbury connection seems sketchy enough on the face of it. But there is no doubt that Arthur actually lived, 14 centuries ago, somewhere in this area of Southwest Britain—a British warrior chief whose armored cavalry had inherited Roman fighting methods, and who successfully held off the invading Saxons. The Camelot skeptics could be wrong. Even so eminent a historian as Hugh Trevor-Roper points out that "myth can be stronger than history,"—and people scoffed at Schliemann when he said he was going to discover the site of Troy.

Because of the Arthurian overtones, the excavations at Cadbury, sponsored by the British Sunday *Observer,* have had enormous news value. But, the intention in excavating the Iron Age hill fort is far broader than just looking for Arthurian traces. A microcosm of early British history, the site shows traces of occupation for some 4,000 years, from Stone Age up to medieval times, and was first heavily fortified in the Iron Age about 400 B.C. Diggers last summer found that some of these walls, burned to the ground by Roman invaders, were rebuilt on a grander scale around 600 A.D.—a period which would fit in with the days of Arthur's greatness.

Cadbury is an important site as much for methods as for discoveries —a testing ground for geophysical survey techniques which, already well-proved in oil prospecting, are comparatively new to archaeology. The 15-acre site was "prospected" by a team headed by Dr. Martin Aitken of the Oxford Research Laboratory for Archaeology, to see which areas would be most likely to yield results. They used a proton magnetometer, which records minute variations in the magnetic field of different types of soil; and a soil conductivity gradient detector, familiarly known as the Banjo, a sort of underground radar which measures differences in radio waves bounced off rock, disturbed soil, metal and so forth. With these machines, a couple of men could discover in one afternoon as much as a team of diggers in six weeks.

The survey of the Cadbury site revealed large post-holes arranged in a circular pattern 45 feet in diameter, characteristic of the round houses of an Iron Age settlement. Much more remarkable was the one apparently square building—for a house or palace of Arthur's time would have been square. Could this be the palace of Camelot? Excitement mounted. Then came a violent storm, the heavens opened (Merlyn's hand at work?) and on the sodden soil, the straight lines were shown to extend impossibly far—they were merely a medieval field boundary. Later, another pattern of straight lines emerged—a most peculiar shallow zig-zag trench. Scholarly brows were furrowed; appeals for informed guesses were sent to the public. Could anybody remember doing military service in these parts and being asked to dig a practice trench? Well—

Searching for Camelot is made easier with tools of the present—here, a soil conductivity gradient detector, called the Banjo, a sort of underground radar which measures radio waves bounced off rock.

Excavation on the site of the Chapel of Saint Swithin at Winchester is in progress here. Wall remains can be seen, and digging proved the saint was buried inside the church, instead of out in the rain.

yes. So it was probably the khaki-clad Tommies of 1914 and not the armored knights of Camelot, who were, alas, responsible. Just before the excavation ended there was further excitement. Traces of a cruciform building were found, which this summer's dig may prove to be a very early Christian church —more likely 10th century than Arthurian.

The Cadbury dig yielded artifacts as well as outlines. A curious find by a gimlet-eyed 13-year-old volunteer was a bronze brooch of unmistakable Anglo-Saxon design. What was it doing in this headquarters of the Britons? It could have belonged to a captured Saxon maiden. Or it may date from the years of peace following Arthur's defeat of the Saxons, when fraternization and even intermarriage between the enemies may have taken place.

The most interesting finds of all were fragments of pottery wine jars, of a type which must have been imported all the way from the Eastern

The earliest mosaic floors in Britain, shown here, were found in the foundations of the largest Roman building in that country—a luxurious palace at Fishbourne with remains of splendid gardens.

Mediterranean. These show that Cadbury was unquestionably the headquarters of a *very* important war lord and chieftain, at the time when the beleagured Britons were trying to beat off the invading Saxons. But was this Arthur's home? He *could* have been there. Learned scepticism abounds; nobody involved with the dig really wants to go further than that. Director Leslie Alcock and his team are satisfied with having established that South Cadbury was the largest hill fort in Britain in the 6th century A.D., and was heavily re-fortified in Arthur's time.

To the sorrow of legend-lovers, archaeology can destroy myths as well as reinforce them. Beside the medieval cathedral of Winchester, an Anglo-American team has been excavating the only Saxon cathedral which survived the Norman Conquest. Last year, Director Martin Biddle found England's earliest-known Saxon wall paintings, and made useful discoveries about the nature of Saxon architecture and liturgical ritual. This year, the team hoped to throw some light on the legend of Winchester's native saint, Saint Swithin.

The tale goes that Saint Swithin, a humble fellow, asked not to be buried in the stately buildings of the cathedral, but in some lowly place outside in the rain, where the feet

Experts and amateurs alike help in the tedious job of excavating an historical site—this one being the Fishbourne palace. Six years of research went into this job, but the finds have been rewarding.

Silbury Hill, a massive man-made mound 130 feet high with a base that extends over five acres, is still a mystery to experts, because archaeological finds differ widely in dating it, but a dig is planned.

of pilgrims would tread. When the monks tried to disobey his orders and move his remains indoors on July 15th, 971, the deceased saint thwarted their plans by causing it to pour torrents for 40 days. And that, so they say, is why we still get wet when it rains on his day.

Well, until this year, the site of Saint Swithin's burial certainly did appear to be out in the cold; but this summer's dig revealed that the plan of the Saxon cathedral at the time of his death would have embraced the shrine, proving that he was, after all, buried grandly inside without a drop falling on him.

Buried Roman luxury

Forty miles southeast of Winchester, at Fishbourne on the Sussex coast, the foundations of the largest Roman building in Britain have been unearthed after six years of patient research by Prof. Barry Cunliffe. Fishbourne was evidently a luxurious place, and contains the earliest mosaic floors in Britain. It measures some 500 feet by 500 feet, with four wings embracing a great central courtyard which had a magnificent formal garden.

Many of the garden's bedding trenches still contain a carefully prepared mixture of l o a m and crushed chalk, to counteract the acidity of the natural subsoil. In one part of the garden, climbing plants were apparently grown with their roots buried in kitchen refuse —a rose-growing method advocated by Pliny in 77 A.D.

Camelot, Winchester and Fishbourne are this season's archaeological "big game" that have attracted most publicity. But smaller digs abound in Britain. Typical of the unspectacular, but scientifically useful, excavations of the summer was the dig at Blewburton Hill in Berkshire. This was already known to be the site of an Anglo-Saxon cemetery, but the object of the dig was to outline the shape and construction method of an Anglo-Saxon hill fort. It was also hoped to make a stratified pottery sequence of Iron Age pot-sherds. Whenever the archaeologists were getting on with seeking out revetments, skeletons kept turning up, and these had to be patiently scraped around and photographed, rather delaying the real work of the dig. One skeleton of a small child had a dagger apparently through its ribs. "Ritual murder?," asked a reporter. Scholars are not to be drawn on insufficient evidence. Director Denis Harding admitted it looked sinister, noted that the dagger was found "nearby" and proceeded with the unsensational study of revetments and post-holes. Just as the dig was scheduled to finish, the team made a rewarding discovery: a set of post-holes in the chalk ramparts, showing that the fortifications had been timber-laced, the first of this type to be found in England.

As is usual in an informal dig of this sort, local residents and unskilled volunteers flocked to the site to look a r o u n d, to peer into trenches, to sit and wash and mark

A small boy found a Roman coin on a soil heap, evidence of the first Roman occupation of a site.

pottery pieces in the summer evenings. A small boy who'd been told by his volunteer parents, "Go off and play and don't be a nuisance to the scientists," returned 20 minutes later with a Roman coin he'd found on the spoil-heap, the first evidence of Roman occupation of this site. He was allowed to join the team.

Cadbury and Blewburton are natural hills which have been fortified by the addition of ramparts. Quite different is Silbury, an astonishing man-made mound some 130 feet high, with a base extending over five acres. A massive piece of civil engineering in any age, it lies only 20 miles from Stonehenge. (See the Stones of Wiltshire, Dec. '67.)

The mystery of Silbury has been baffling pre-historians for years. An attempt at tunneling in 1848 disclosed picks made from red deer antlers. These have just been carbon 14 dated by a New Jersey laboratory. They date from a thousand years later than the presumed time of the Silbury construction, hitherto thought to be around 1800 B.C. The dates just don't fit. And this is one of the things Prof. Richard Atkinson and a team from Cardiff University hope to be able to clear up, in a three-year dig which British Broadcasting Corporation Television is sponsoring, starting at Easter. The team will carve a new entrance which will join up inside with the earlier tunnel; it will be a well-reinforced passage large enough to permit the entry of TV cameras, so that finds, if any, can be televised "live."

An increasing number of Americans are taking part in British excavations. The Council for British Archaeology has appointed two agents who can give advance information about proposed fieldwork to help potential volunteers. They are Dr. Bernard Wailes, department of anthropology, University Museum, 33rd and Spruce Streets, Philadelphia, Pa. 19104; and E. Hunter Ross, 390 Morris Ave., New Jersey. The council also publishes a useful Calendar of Excavations which gives details about what accommodation is available, whether boys or girls are needed and whether financial help is offered. Though preference is usually given to experienced diggers, there is often scope for the unskilled volunteer who is prepared to muck in on some of the less glamorous tasks—washing pottery, pick-axing trenches or showing visitors around the site. Archaeology is thriving in Britain as never before.

The Calendar of Excavations is issued monthly from March to September by the Council for British Archaeology, 8 St. Andrew's Place, London, N.W.1. The annual subscription is $1.10, or $2.10 by air mail.

ICHTHYOLOGY

Killers of the deep

BIPS

To the victor belong the spoils, and there's no doubt what the spoils will be in the battle that ensues when these two killers of the deep — shark and octopus — meet on the floor of the ocean.

The shark, who has been swimming on the water's surface, dips to the ocean bottom, angered by advances of octopus.

Lower left: The octopus rises to emit his inky fluid in self-defense, but not before the shark has severed a tentacle. Below: In a cloud of ink, octopus grips his prey.

The large octopus, who makes his home in the rotten hulk of a sunken ship, eyes the shark warily—as it moves in optimistically for a "kill." His eight strong tentacles, covered with rows of suction cups, are ready for the struggle about to begin.

The octopus outlasts the shark by wrapping his arms around him tightly and hanging on while the fish struggles to loose himself from the grips. All is futile, and when the shark collapses, the octopus finds his gill flaps and closes them. The struggle is over, and the victor drags away the spoils of battle to the privacy of his sunken ship.

DENTISTRY

Don't grind your teeth away

Teeth grinding, although dismissed lightly by some and ignored altogether by others, should be definite cause for concern to its victims.

by T. M. Graber, D.D.S.

Do you gnash, rend or grind your teeth together when you sleep? Do you clench your jaws so tightly that when you wake up in the morning you feel as if you had been chewing bubble gum all night? You may not, but millions of people do. Because this exercise usually occurs while sleeping, the victim seldom realizes what is going on. And even the most confirmed night grinder can seldom duplicate the activity while he's awake.

Yet the evidence is there: teeth that are loose, polished, chipped and worn down, jaw joint disturbances with clicking and popping, limited motion of the jaw, radiating pains and headaches. All these conditions can be caused by teeth grinding and jaw clenching.

The dentist refers to night grinding as bruxism. Estimated to occur in at least 10 percent of the population, bruxism counts close to 20,000,000 Americans on the "I do" list. Yet relatively little has been written about it in medical and dental literature, and no firm statistics are available because of the difficulty of getting objective data. For example, it was once thought that bruxism was limited primarily to adults. Now it's known that children frequently have the same problem.

What causes this spasmodic contraction of the muscles that seems to occur rhythmically in the lighter periods of sleep? Much research remains to be done, but there are certain obvious conclusions that can be drawn.

Orthodontists, the dental specialists who correct abnormal "bite" and "crooked teeth," have known for some time that an abnormal "bite" predisposes the patient to night grinding. Particularly significant is the so-called "deep bite" in which the patient's upper teeth bite far over the lower teeth. Excessive overbite prevents normal lateral, side-to-side movements of the lower jaw, a functional stimulus the patient apparently misses.

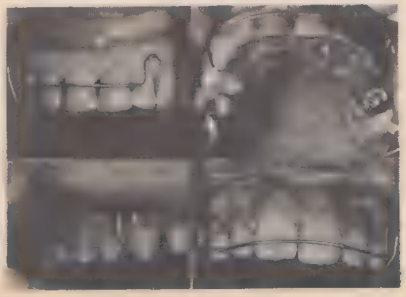
A second cause of night grinding is a dental restoration or filling that has been left "high," or a tooth that has erupted beyond the level of the other teeth because its opposing

tooth is missing. The premature contact as the jaws are closed often serves as a "trigger" that sets the bruxing cycle in motion. Sometimes merely grinding down the offending cusp or filling eliminates the habit.

For a long time psychiatrists have been aware that bruxism is a tension release. High emotional tension often precedes intense bruxism. Fatigue may be a factor, too. People who have frustrations and problems during the day are more inclined to grind their teeth at night. A nervous, emotional child is more likely to grind his teeth than the placid, phlegmatic child. If emotional factors are combined with the physical characteristics of an abnormal bite or abnormally positioned teeth, the dentist will have no difficulty diagnosing bruxism. He sees the telltale polished and worn surfaces, sometimes with the outer enamel layer of the teeth actually fractured away. The damage is frequently in the canine or "eye tooth" area. Occasionally teeth are ground down right to the gum line.

Instead of grinding their teeth, some patients clench their jaws together with strong contractions of the chewing muscles when they're asleep. When they wake up in the morning, their jaw muscles are tired, and they feel they have to "unlock" the jaw by swinging it first to one side and then to the other. Sometimes there is actual soreness of the muscles in the cheeks. It's more difficult for the dentist to diagnose the clenching habit, because there's less visual evidence. But the same predispositions

Right: The "deep bite," as seen in figure A, prevents normal chewing and often causes excessive wearing away of teeth, as shown in figures B through H. **Below:** The wire and plastic "bite plate" is worn at night to prevent damaging effects of overbite. Wire over front teeth keeps them from fanning out. The plastic portion behind teeth prevents "trigger" area from contact and starting grinding cycle.



are there: abnormal tooth position, excessive overbite, emotional tension. The wearing away of tooth substance in grinding can actually be a safety valve because jaw clenchers show more jaw joint disturbances. The clicking or popping of the jaw joint when the mouth is opened can be a forerunner of pain, headaches and even limited opening of the jaw.

Victims of acute radiating pains and headaches often go from doctor to doctor getting cortisone injections and pain killing injections, having articular discs removed from the jaw joints and undergoing a variety of operations when, in reality, the problem is tied into the grinding or clenching habit and an abnormal bite.

'Bite Plate'

What can be done? Fortunately, these conditions can be controlled very simply with a removable dental appliance which is worn at night. The dentist calls this plastic device with little wire attachments to hold it on the teeth a "bite plate." When it is placed in the roof of the mouth, the patient cannot bring his teeth together, preventing the excitation of the "trigger" area. By wearing a bite plate at night, millions of adults could prevent the undue wearing away of the teeth, jaw joint disturbances and soft tissue lesions and loss of bone caused by excessive pressure and jiggling of the teeth.

A bite plate is not only a "crutch." It can be therapeutic, particularly with younger individuals. By preventing the overclosure of the lower jaw and by keeping the teeth apart, the bite plate actually improves the way the teeth meet. Over a long period of time, the plate will bring the upper and lower back teeth together, eliminating some of the excessive overbite.

Most people who wear bite plates learn to rely on them and can't go to sleep without placing the bite plate in their mouth. Thousands of people who have had the symptoms of jaw joint disturbance find complete relief by wearing a bite plate at night. It is infinitely simpler and less likely to produce adverse effects than injecting pain killing substances into the jaw joint itself.

The next time you find someone who has the symptoms of a teeth grinder or jaw clencher, suggest they see their dentist. Let him check whether this is a bite problem or not. Let him look at the teeth and see whether there is undue wear which can be prevented or any tissue damage which can be eliminated. If the condition is essentially a sign of emotional stress, a referral may be made to a psychiatrist. If there is an imminent jaw joint disturbance, the dentist may either prevent it or treat it. Most of these problems respond very well to proper dental guidance and the use of the bite plate. If you must grind, it's easier to grind away the plastic of the bite plate than the enamel of the tooth.

SCIENCE DIGEST SPECIAL

MAN THE CREATOR

by Bruce Frisch

To learn to control life, we must create it, says the Russian scientist Alexandr Oparin. We are progressing so quickly toward this goal these days it is hard for science prophets to keep up their status as visionaries.

Researchers on viruses are leading the way. "Today we're working with viruses. Tomorrow . . . we'll be building complete living systems," says Prof. Sol Spiegelman of the University of Illinois. He wouldn't be surprised if the synthesis of a cell happened "within 10 years."

Prof. Charles Price of the University of Pennsylvania called for making the synthetic creation of life a national goal. Asked if such a program would extend to the creation of new organisms as complicated as humans, he replied, "I couldn't imagine this would not happen in a century or so." Even as he spoke there emerged the new field of cell hybrids that may create new species very soon.

By far the most ambitious scientists are those who are trying to duplicate the original living cell the way Nature made it. They don't even know what the cell they are trying to make was like. And experts agreed a fossil of it couldn't exist. Fortunately, a few people stubbornly searched anyway and have made spectacular progress.

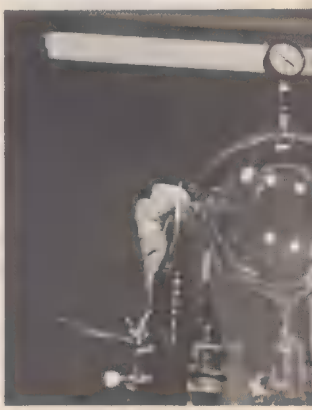
Should these men reenact the origin of life, they will make man a creator in truth.

From the original recipe

THE whir of an atom smasher in 1951 stirred in scientists the dream of building life out of raw chemicals just the way Nature had done. Dr. Melvin Calvin bombarded carbon dioxide dissolved in water with the high energy radiation from the 60-inch cyclotron at the Berkeley campus of the University of California. What emerged were *organic* chemicals, demonstrating how the first steps toward life may have begun on primitive earth. Although theorizing on "creation" had started long before, British scientist, J. B. S. Haldane, wrote a book on the sub-

Leading theoretician on the creation of life, Dr. Alexandr Oparin (left), talks to scientific colleague T. Dobzhansky.

Prof. Sidney Fox, right, of the University of Miami has developed outline for a how-to-do-it act of creation.



ject in 1932, and so did the Russian Alexandr Oparin, in 1934. But it was Calvin who set off a flurry of actual experimentation.

Another boost came in 1957 when Sputnik touched off a rocket race between the United States and the Soviet Union. With the possibility of reaching another planet imminent, scientists found themselves unprepared. How would they detect primitive life on another planet? Well, how had it started, and what forms had it taken on earth? They didn't know. So a new wave of experimentation was launched.

Today, Dr. Sidney Fox, head of the Institute of Molecular Evolution of the University of Miami, can propose a complete outline of the origin of life and say that "almost entirely within the last decade every step in the theory has been tried in the lab. The problem is regarded by increasing numbers of theorists as solvable; the more favorable evaluations regard the problem, in principle, as more solved than unsolved."

In simple how-to-do-it steps, the "act of creation" as seen by Fox and Oparin goes like this: 1. From the gases in the primitive atmosphere make the simplest chemical building blocks of life. 2. String together, or polymerize, the simple chemicals into huge macromolecules similar to protein. 3. Package the protein-like material into concentrated packets,

walled off from the world but trading freely with it—like a living cell, yet lacking life. 4. Select by competition from among the packets to evolve one bent only on growth and multiplication—in short, touched with life.

The natural process began with the formation of the earth four to five billion years ago, out of dust and debris. None of the chunks was big enough, Lauriston Marshall and the late Lloyd Berkner of the Graduate Research Center of the Southwest have pointed out, to bring with it an atmosphere. Earth was airless and cold. Eventually internal radioactivity heated it up and started volcanoes spouting lava and gas.

Most scientists agree with Oparin, who believes the carbon now tied up in coal beds, coral reefs, chalk cliffs, oil and living matter was then in the form of methane, our swamp and sewer gas.

Nitrogen, which today makes up 80 percent of the atmosphere, he thinks, was combined with hydrogen as ammonia. Water vapor made up the balance.

There was almost no oxygen. Photosynthetic life has made the oxygen we breathe. Without oxygen there was little ozone (O_3) that today screens out ultraviolet light 20 miles over our heads. We use ultraviolet lamps to sterilize things. Primitive earth was bathed all day by its rays.

The conditions on primitive earth would kill us, but they were right for the origin of life. Our present atmosphere would not allow life to be born, Louis Pasteur proved a century ago. The amino acids from which life is built would be destroyed by oxygen unless shel-

Dr. Cyril Ponnamperurna sends sparks through simulated primitive atmosphere.

Dr. Clifford Matthews (left) tests his theory of steps to protein formation.

tered from it within the cell.

Earth was parched, too, having only about one-tenth the present amount of water, estimates Dr. Harold Urey, Nobelist at the University of California. Volcanic steam slowly filled the oceans. At the time experimentation started on the origins of life, Dr. Urey had written a book about the formation of the planets. Drawing on his knowledge of the primitive atmosphere, he suggested experiments to a student of his at the University of Chicago, Dr. Stanley Miller, who carried them out. Inside a glass bottle Miller sealed a colorless mixture of methane, ammonia, water vapor and hydrogen, simulating the primitive atmosphere, through which he discharged sparks, simulating lightning. Reactions formed several organic chemicals, including amino acids, the building blocks of protein.

Since then other scientists have demonstrated several other presumably natural ways to form amino acids, as well as the building blocks for carbohydrates and nucleic acids, and ATP, the molecule that powers the cell. Some workers use ultraviolet as an energy source instead of electricity. So ultraviolet, which can kill life, may have been necessary for its formation.

The next step is to join the small molecules into the large, complex proteins, carbohydrates and nucleic acids. For years the theory was popular that the small molecules washed into the ocean to form a thin soup. Given enough time the right accidents would happen to join them up in the right order. Presto, there would be a molecule of DNA.

Oparin wryly notes, "Physicists assert that, in principle, it is possible that, by chance, the table on which I am writing might rise up of its own accord into the air owing to the simultaneous orientation of the thermal movement of all the molecules in the same direction." But he wouldn't base his scientific work on that possibility. It is also turning out that Nature had less time than was thought, as older and older remains of primitive life are found.

Scientists began suggesting ways the reactions might have been speeded up. Dr. Clifford Matthews of the Montsanto Co. sparked methane and ammonia, hooking together hydrogen, carbon and nitrogen into hydrogen cyanide. The hydrogen cyanide, in turn, reacted with ammonia. Before the products of a lightning bolt hit the ocean, he thinks, some were already protein. They accumulated on the surface, not as a thin soup, but as a concentrated scum.

The stage was set for step three, the gathering of protein into cell-like packets. Dr. Fox has a forceful demonstration of this. He spreads a powder of amino acids over a chunk of volcanic rock and puts it in an oven at cake-baking temperature for several hours. When the rock comes out, the amino acids have polymerized into protein-like substances he calls proteinoids.

Over the top of the proteinoids on the rock he pours water and allows it to cool. Through the microscope the proteinoids are seen to have been formed into globules, what Dr. Fox has named microspheres. They are the same size and shape, he points out, as coccoid bacteria, which some regard as the most primitive bacteria.

According to Dr. Fox, microspheres absorb chemicals ("food") from the surroundings. They can sprout, and sprouts knocked off will grow into full-size microspheres, a sort of reproduction. If the acidity of their pool is raised, they divide, also reproduction. Dr. Fox has introduced zinc into microspheres to mimic metal-carrying enzymes that split ATP and tap its energy. Although he found the reaction much weaker than in nature, considerable activity was there.

Tremendous numbers of microspheres beneath an ultraviolet-shielding layer of water would compete, with those which absorbed "food" fastest, growing and dividing at the expense of others just as in life, he suggests. Those would fare best which had the most powerful enzymes to channel chemical activity inside the sphere from aimlessness directly toward monomaniacal self-sufficiency and self-perpetuation.

Thus three of the four steps in originating life have been completed in the lab. Scientists are now working on the fourth and toughest, organizing a microsphere into a cell. We should not be impatient. They have been working 17 years; it may have taken Nature two billion.

The search for the original cell

When J. William Schopf, ambitious to study ancient life, was graduated in geology from Oberlin College in the early '60s, he found "Precambrian life was a big mystery."

Scientists who were trying to duplicate the original living cell in the lab had no model to copy. The oldest well-studied fossil dated from

Harvard's Dr. Elso Barghoorn is pioneer in the discovery of Precambrian fossils.

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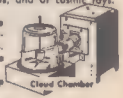

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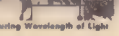

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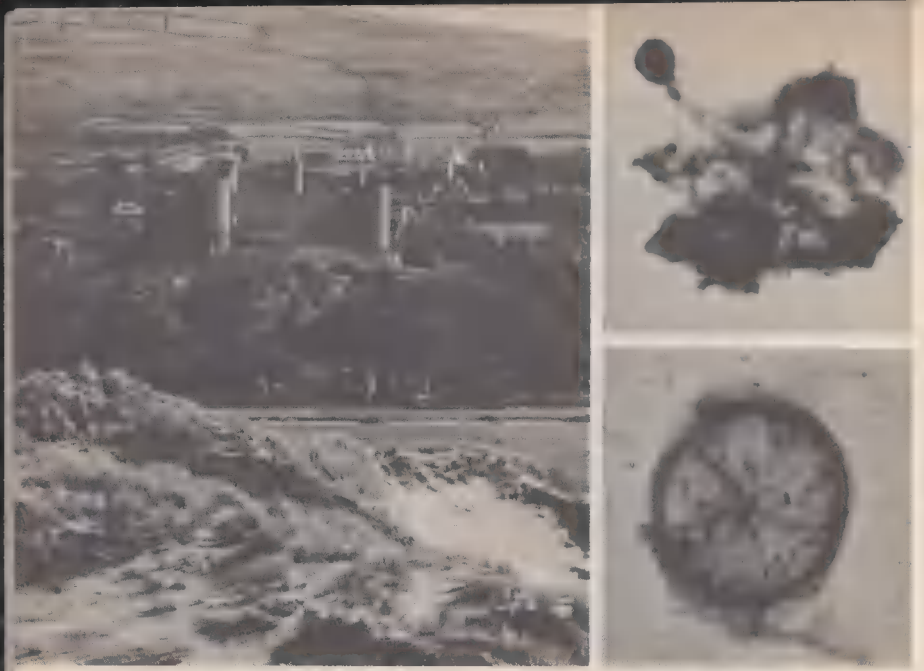


Fossil Kakabekia-form found in two billion-year-old rock (upper right) resembled organism (lower right) dug up a few years ago from courtyard and near walls of Harlech Castle (left) by Dr. Sanford Siegel. Organism thrives best in mixture of air and ammonia.

Cambrian times 600 million years ago, much too recent. "There was a myth that there was nothing like a Precambrian fossil," Schopf recalls. Only P. E. Cloud Jr. at UCLA and Elso Barghoorn at Harvard were working on the problem, so he had little trouble deciding where to go. He went to Harvard, and his timing was perfect. He got in on the ground floor of a new science. Today Schopf is an authority on ancient life at the age of 25.

The trail of life had been lost at 600 million years before the present partly because it marked a time of transition from single to multicelled life, and single-celled life was smaller and more fragile. The record of the times after this is clearly traced out by fossils buried in sediments which later hardened into rock. Heat and pressure have metamorphized most older sedimentary rock into other kinds, destroying all fossils in the process.

In the sedimentary rocks that remained there were fossils. Scientists just hadn't been looking closely enough. Through the electron miscroscope one billion-year-old rocks from the Bitter Springs Formation of central Australia and from Michigan and Montana were seen to imprison several kinds of single-celled organisms. Among these fossils, animals, in the form of protozoans, make their last appearance as we work backward in time. Also present were fossils indistinguishable from some present-day types of algae. Over the last

billion years, Barghoorn and Schopf feel, they may have remained unchanged by evolution.

Fossils almost twice as old were found in the 1.9 billion-year-old Gunflint Iron Formation along the northern shore of Lake Superior. S. Tyler, a Precambrian geologist at the University of Wisconsin, turned up the fossil in 1953, and he and Barghoorn spent a leisurely 10 years studying the rocks before announcing detailed findings. The rocks were dense with life. It appears to be mostly photosynthetic algae which grew in sheets or mats in shallow water, but there were also bacteria and other organisms.

One fossil organism found near Kakabeka Falls in Ontario was shaped like an umbrella with a straight, bulbous handle, so was named *Kakabekia umbellata*. When Dr. Sanford Siegel read about *Kakabekia* in the winter of 1965, it sounded like a living microorganism he had found in soil he had dug up at Harlech Castle in Wales the previous summer. Dr. Siegel pulled out his old sample for reexamination. In his lab at the Union Carbide Research Institute in Tarrytown, N. Y., he tried growing his microorganism in three different atmospheres. In air it didn't grow at all. In methane and ammonia it grew modestly well. In a mixture of air and ammonia it grew best. "The *Kakabekia*-like forms appear to be a relic of the Precambrian," he concluded, but they had been discovered as fossils first.

Kakabekia has probably survived only in soil where the air is reduced and decay furnishes ammonia, says Dr. Siegel. Harlech Castle may be particularly hospitable to it, he says, because it "is frequented by tourists, many with small children. It is not uncommon for the soil near the castle walls to receive relatively copious quantities of human urine, an excellent source of ammonia, during the course of the holiday season. Hence, soil in the area sampled may have been exceptionally well provided with ammonia for many generations."

Kakabekia and most of the other amazing variety of organisms in Gunflint sedimentary rock disappear from more ancient rock. In 1966 Barghoorn and Schopf announced they had found fossil life in rocks 3.1 billion years old. Barghoorn had chipped the rock from a road-building cut near the entrance to the Daylight gold mine in South Africa. Under the electron microscope they sighted organized layers of spheres that looked like algae, rods they named *Eobacterium isolatum* and filaments "almost certainly biogenic" but which require further study. Other workers have found chemical evidence of photosynthesis in rock from the same formation.

What was the original cell like? The consensus of scientific opinion is that it was a good deal simpler than even these bacteria and algae. Immersed in geologically formed proteins and other organic compounds, "the first living, simple form found itself in a mass of spare

parts," speculates Dr. Henry Isenberg, microbiologist at the New York Downstate Medical Center. It probably used them directly. Some algae can switch from photosynthesis to this mode of existence today and much of higher life depends on some preformed compounds like vitamins.

Immediately, with its birth, life destroyed the conditions necessary for its emergence, observes Oparin. It stripped the oceans bare of free parts and excreted contamination. As compounds disappeared, continues Isenberg, probably only those cells survived that could make their own parts from simpler materials.

This original cell may be found yet. Schopf, the man who has helped find life going back 3.1 billion years, says, "It's a good bet we'll come up with some older."

Technician for Dr. Howard Green prepares culture of man-mouse hybrid cells.

Of mice and men

In Greek mythology there was a fire-breathing monster with a lion's head, a goat's body and a serpent's tail called a chimera. Chimera also means an impossible or foolish fancy. Today something very like a chimera is no longer so impossible (although opinion is divided on whether it is foolish).

The possibility was first sprung upon the public in 1965 when Prof. Henry Harris of Oxford University reported he had crossed a man and mouse. The actual partners were mouse cancer cells and cells called HeLa cells from a human cancer.

Harris mixed mouse and human cells with Sendai virus placed for three minutes under an ultraviolet lamp. All that remained of the virus's ability to penetrate the cell was the capacity to make the membranes sticky. As many as 20 cells in a clump stuck to each other and their cytoplasm blended. In some of these fused cells the nuclei combined into one. Hybrids survived up to 15 days, but no cell could be proven to have divided.

For almost a century, Harris explained, it had been known that

some diseases, particularly virus diseases, caused cells to fuse in the body. Later it was learned that occasionally cells in culture fused spontaneously, probably, Harris guessed, because of an undetected virus.

A three-man team headed by G. S. Barski at the University of Paris began exploiting the spontaneous hybrids to make genetic studies. In 1960 they became the first to announce the combining of cells from different animals, two breeds of mice.

Boris Ephrussi, also at the University of Paris, watched their work, sensed its potential and set out for himself to repeat their experiments, then extend them. Early in his quest he crossed the ocean to Western Reserve University in Cleveland. There he joined forces with zoologist Mary Weiss.

Ephrussi started out making only mouse-mouse hybrids. In some cases he joined normal cells to tumor cells. There had been an hypothesis that the wild growth of cancer was caused by the lack of a control gene. If this were so, the normal cell should have provided the hybrid with a control gene that would have made it grow normally. Instead, the hybrid was cancerous.

Ephrussi and Weiss went on to try crossing cells from different species, mouse and rat. "To our surprise, they were perfectly viable," says Dr. Weiss. Back in Paris, Barski's group was joining mouse and hamster as well as mouse and rat. Harris has created human-rabbit, human-rat and human-chicken crosses. But Ephrussi and Weiss were one step ahead. Their mouse-rat hybrid was the first interspecies cross to multiply.

After this the team broke up. Dr. Weiss went to New York University to work with Toronto-born-and-educated Dr. Howard Green. Dr. Ephrussi returned to Paris.

Using the same techniques successful in Cleveland, Weiss and Green attempted a human-mouse hybrid. Since spontaneous cell fusions are rare compared to the wholesale fusing caused by Sendai virus, they had to use a special method to find and separate them. They deliberately chose mouse connective tissue that lacked the enzyme needed to take a vital substance called thymidine directly from the liquid medium in which it was cultured. The mouse cells had to make their own thymidine.

After mouse cells and human embryo lung tissue had been mixed and a few spontaneous fusions had presumably taken place, aminopterin was added. This killed all the mouse cells by preventing them from making thymidine. Human and human-mouse cells survived, although there were so few hybrids that none could be seen at first. After two weeks the hybrids had multiplied enough to be seen as distinct colonies which could be picked out and cultured separately. Up to 120 generations were counted, record longevity for a human hybrid line. "They could live indefinitely," says Dr. Green.

With their hardiness proved, could cell hybrids be used in another line of research being pursued by Dr. Beatrice Mintz at the Institute for Cancer Research in Philadelphia?

Dr. Mintz has taken the developing eggs from one black mouse and one white mouse at an early stage when they were made up of a small number of cells. After removing the surrounding membranes she placed them together, and they adhered. Within roughly a day the cells became thoroughly mixed, but each remained all black or all white. This composite egg was put inside a third, "incubator" mother. Growth, birth and rearing continued in a perfectly normal way. The mouse born had four parents plus a mother who was no relation.

Most often a mouse produced in this way has black and white stripes running across its body. Each band stems from all-black or all-white cells. There is evidence of similar marbling of parentage internally, too, but in differing patterns. Since 1965, over 500 allophenic mice have been born and have begot over 25,000 offspring.

Dr. Mintz says "chimera" is not a correct term for her mice. "Chimera" is also not strictly correct for hybrids, since every cell would derive from two species, but it seems the most nearly correct and most used word. In any case, could two ova from different species be hybridized and grown into a fully developed chimera-like animal? In a BBC TV show, Prof. Harris discussed the possibility of mouse-rat, man-ape chimeras. Within a few years, he said such a fusion could be a practical possibility. Says one leading U.S. researcher with hybrid cells: "In time, I don't see why it couldn't be done. But there is a large moral question of whether it should be done."

The virus-makers

Even the first, simplest cell Nature created was immensely more complicated than the virus. Thus many scientists felt the quickest way to create synthetic life was to learn to create a virus. After the swarm of advances toward this goal in 1967, it looks as if they may have been right.

A two-pronged attack on the problem is being made. First, learn how to put together the parts of a virus. Second, learn how to put together the RNA or DNA that makes the parts.

One of the simplest of the viruses is the tobacco mosaic virus. It consists of a strand of RNA inside a protein tube or jacket. In cells a double strand of DNA carries all the plans and operating instructions. RNA bears its messages and performs the actual assembly of proteins. In a virus, a single strand of DNA, or even RNA, stores the genetic information.

No complex auxiliary machinery for metabolism and protein manufacture clutters the inside of a virus. It depends on cells for these

Drs. R. S. Edgar and William Wood of Cal-Tech assembled a T4 virus from parts.

Right: The T4 virus has over 100 genes, and all the parts had to be made separately.

things. That is why viruses must have appeared after cells. A tobacco mosaic virus, for example, injects its genetic material into the cells of tobacco leaves, commandeering cell machinery and putting it to work making virus. The virus dissolves the cell membrane and releases its new generation.

In 1955, the assembly of virus particles that normally takes place inside a cell was performed in a test tube for the first time by Prof. Heinz Fraenkel-Conrat, a biochemist at the University of California. He separated RNA from jackets and put them back together again.

Twelve years passed, during which no other virus was reconstituted. Then, in 1967, the trick was turned four times. At Purdue University, experimenters disassembled, then reconstituted the RNA and spherical sheath of the cowpea chlorotic mottle virus. Later in the year, two graduate students at Harvard put together the three-piece bacterial viruses R17 and MS28.

The biggest leap was made by geneticist Robert Edgar and biochemist William Wood, who constructed the much more complex T4 bacterial virus. Instead of the five or six genes of the tobacco mosaic virus, T4 has over 100 genes. Instead of two parts, it has at least six. As a result, Dr. Wood and Dr. Edgar could not break apart viruses and put the same pieces back together. They had to make all the parts separately.

Synthesis of RNA and DNA that direct this whole operation began in 1955. Dr. Severo Ochoa at New York University combined the four chemical building blocks of which RNA is made, the enzyme that links them together, and RNA as a *template* for the enzyme to use in de-

termining their order. He got out fresh RNA.

Meanwhile, a young medical student, Arthur Kornberg, had "got tired of seeing something go in one end of an animal and come out the other without knowing what went on in between," and gone into biochemical research rather than practice. In 1957, while head of the department of microbiology at Washington University in St. Louis, he did for DNA what Ochoa had done for RNA. For this work they shared a Nobel Prize in 1959.

The genetic material they made looked and tested like the real thing except in one way—it didn't work; it did not direct the making of protein. Apparently the enzyme they extracted from cell sap was contaminated with just enough of other enzymes that attack RNA and DNA to render them impotent.

The purification problem was licked in 1965 by Dr. Sol Speigelman of the University of Illinois.

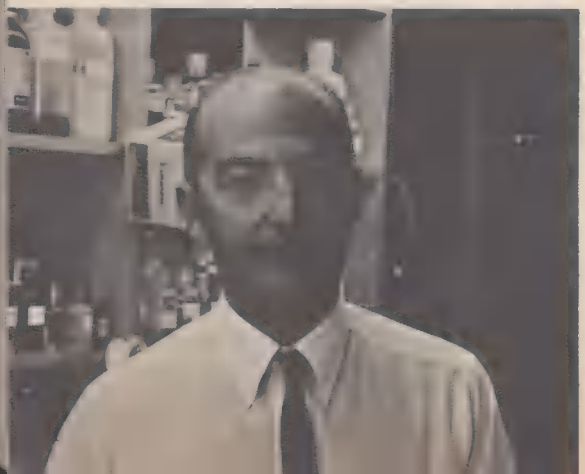
Greater acclaim awaited the man who could make synthetic DNA, because it is the carrier of genetic information in higher animals.

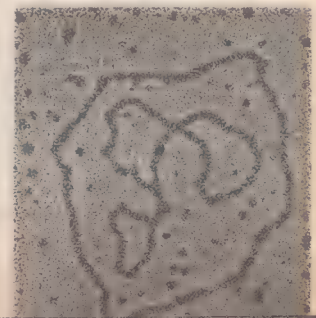
Prof. Kornberg, now at Stanford University, alertly coupled some recent discoveries with his own experience to claim the prize last December. The enzyme that the intestinal bacteria Eschericia coli uses to make its own DNA will also make the DNA of the phi X174 virus that infects it. The resulting DNA is linear, however, and phi X174 DNA must be in a circular form to be infective.

Early last year a second E. coli enzyme was found for joining the ends of the DNA strands. Kornberg used it to make DNA that E. coli turned into complete, infectious phi X174 virus.

"Before too long," says Kornberg, "I believe that it will be possible to circumvent the need for an intact cell."

After the virus should come the cell, for these may not be the ways Nature made its first cell, but they are probably the ways man will make his.





Dr. Arthur Kornberg of Stanford and his creation (below). The tiny double viral DNA rings he synthesized are seen in an electron micrograph — the first creation of synthetic DNA.

I prescribe — for Arteriosclerosis

by Joseph D. Wassersug, M.D.

THERE are two different aspects to the problem of arteriosclerosis, or hardening of the arteries, and both are important in the treatment of the condition. First, you can consider it as a general disease, related to dietary, hereditary and hormonal disturbances. Secondly, you can think specifically of those areas of the body where the arteries are commonly narrow and hardened. Let's consider the general problem first.

Doctors still don't have a complete understanding of arteriosclerosis, but they do have a working knowledge of it. About 40 years ago a Boston pathologist, Dr. T. Leary, found he could force-feed cholesterol to rabbits and dogs and give them the disease. Cholesterol is a greasy chemical compound (technically an alcohol, not a fat) that gets under the inner lining of the arteries and disrupts them. Calcium and other constituents in the blood play a further destructive role. The arteries lose their elasticity, becoming narrow, rough and hardened.

As an internist, I'm more concerned with the practical application of knowledge than with theory. From the practical standpoint, what do I know about arteriosclerosis, and how can this information help my patients?

Animal fats are rich in cholesterol, so diet is important. But I'm concerned about fats in general, not merely cholesterol. I advise my patients to restrict or reduce their intake of animal fats, which means less butter, milk, bacon, ice cream, eggs, animal shortening, cream and succulent steaks. In most cases, I provide my patients with printed lists telling what foods are low in cholesterol.

But such diets are also usually low in calories, and I emphasize low total caloric intake even more than low cholesterol — for two reasons: (a) it is almost impossible to eat a low-calorie diet that is high in cholesterol. (b) a low-calorie diet also cuts cholesterol.

I must say something here about polyunsaturated fats (present in considerable amounts in corn, cotton and safflower oils) even though I don't "push" them too hard in my practice. Diets high in polyunsaturated fats lower blood cholesterol and some of the other fats in the blood. One of the polyunsaturates, linoleic acid, is especially helpful, even though its cholesterol-lowering action is not yet completely understood. Many specialists believe that diets rich in polyunsaturates are useful both in

This is a normal, undamaged artery.

Deposits begin to form on inner lining.

the treatment and prevention of generalized arteriosclerosis in large and small blood vessels.

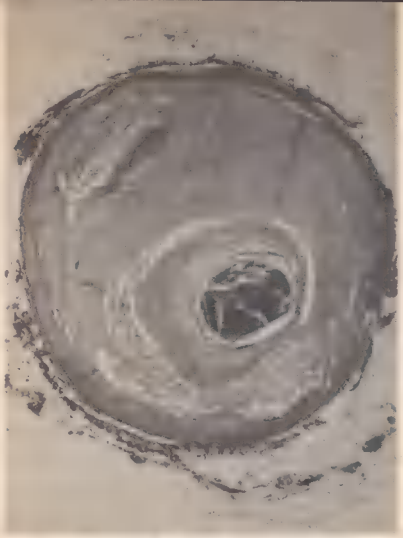
But I don't prescribe polyunsaturates routinely or frequently because I believe such a step would remove the emphasis from where it logically belongs. Most patients who need such a diet are usually too fat to begin with. They need a general program of weight reduction.

For most people a simple way to avoid arteriosclerosis is to watch the scales and make every effort to keep weight down to average or lower than average levels. Furthermore, most persons should avoid foods that are rich in animal fats. Fruit, vegetables and low-calorie beverages are better snacks than ice cream, cakes and pies.

One more thing: I must point out that I do not place elderly patients on low-cholesterol diets. If low-cholesterol diets are to be effective at all, they should be started when the patient is in his early teens or twenties. To wait till a man shows evidence of advanced arteriosclerosis before placing him on a diet is both stupid and cruel. It is stupid because it closes the garage door after the Mustang is stolen. It is cruel because it deprives an elderly person of his usual dietary habits.

If good eating habits are to be of value they must be instituted when the patient is young. I suggest that every high school boy and girl be taught what constitutes a low-cholesterol and low-fat diet and that awards for excellence in dieting be offered at graduation. The youngster who is urged to eat more and gain weight so that he can get on the football team, for example, may be swapping early disability and death for temporary "fame."

Another approach to keeping the cholesterol down is regular exercise. Some years ago, research on



Channel is now blocked by a blood clot.

athletes by the Harvard School of Public Health showed that as long as exercise was adequate, cholesterol blood levels remained normal. On the other hand, the athlete who ate a heavy meal and did not exercise had increased blood cholesterol after eating. What is true for the athlete is probably also true for the average person.

This does not mean that I urge everyone who comes to my office to do push-ups or play a set or two of tennis after a heavy meal. Quite the contrary. Exercising with a full load in the stomach may be dangerous for some people because it places too great a strain on the heart. Vigorous exercise after a heavy meal may promote a "coronary." A brisk walk back to the office after a light lunch may be a reasonable compromise.

What else do I know about arteriosclerosis? At least three more things, although some may be disputed. First, some kinds of hardening of the arteries run in families. Second, arteriosclerosis is more likely and comes earlier when a person has diabetes. Third, it is related in some cases to a low thyroid condition. To what practical use can we put this information?

Some families show a significant tendency to high blood pressure, high cholesterol and arteriosclerotic disease. These patients, I believe, should be put on low-cholesterol, low-calorie diets early in adult life, if not sooner. To wait until the patient has had a "stroke" or a "coronary" is to wait too long. However, I must admit that most patients with this problem do not easily follow advice. It may be that their constitutional makeup is such that it is no more possible for them to follow my dietary orders than they could fly by flapping their arms. Their inherent genetic tendency may be a delayed time bomb that goes off in spite of all our present-day knowledge and efforts. The doctor can only do the best he can with the medical information and treatments that are currently available.

Since many cases of diabetes show a tendency to hardening of the large arteries and narrowing of the smaller vessels, it is important to keep every diabetic under a strict medical control program. Otherwise blood vessel changes in the eye that accompany diabetes may lead to premature loss of vision. In the coronaries, such changes may provoke a heart attack. In the legs, they may cause

gangrene. Hardening or narrowing of blood vessels also interferes with circulation, damaging organs ordinarily nourished by these arteries.

The problem of low thyroid function is usually easier to manage. About a dozen different tests are available for diagnosing a sluggish thyroid (hypothyroidism), and there are several good thyroid-type medicines currently in use.

Old remedies didn't work

I do not believe that any of the older anticholesterol medicines (except the polyunsaturates which are really foodstuffs and not medicine) had any practical value in spite of their wide use. Not too long ago one such preparation was taken off the market because it had a serious and unexpected side-effect — eye damage. Other current products containing *nicotinic acid* are somewhat erratic in their behavior and may cause annoying flushing and redness of the skin. Two medicines just released are, however, based on good research and may yet turn the trick.

There is some question as to whether lowering blood cholesterol alone will actually prevent hardening of the arteries or reduce its severity if it already exists. Furthermore, cholesterol is essential to some vitamins and hormones. Any extensive lowering of cholesterol may, therefore, be nutritionally unwise. It is best, I believe, to pursue a middle course. I advise my patients to keep thin, eat sparingly of animal fats, take reasonable exercise and to keep any diabetes or hypothyroidism under as careful control as possible. Special cases may warrant special therapeutic approaches.

Although arteriosclerosis is usually a generalized disease affecting many blood vessels at the same time, it seems to have a predilection for certain organs such as the heart, the eyes, the brain and the legs. At least its damaging effects are most striking in these cases.

The arteries in the heart are the coronary arteries and any narrowing or blocking of them is called "occlusion." Clotting of blood within blood vessels is spoken of as "thrombosis." Destruction of heart muscle following a blockage or clot is termed "myocardial infarction." And the most common cause of narrowing, obstruction and clotting within the coronaries, is arteriosclerosis.

Prevention of coronary arteriosclerosis begins with following the general principles of weight reduction and eating a diet that is relatively low in animal fats. If the patient has angina (intermittent and incomplete narrowing of the coronaries), a variety of medicines can be prescribed which tend to dilate or open up these affected blood vessels. I believe such medicines are helpful and I prescribe them.

Arteriosclerosis may also harden the blood vessels in the legs. Early signs may include a sensation of coldness in the feet or cramping of the calf muscles after walking short

When hardening of the arteries reaches the brain, a stroke often results. It can be mild or deadly.

distances, a condition called "intermittent claudication." Confirmation of such blood vessels narrowing can be obtained by a variety of methods, including infrared photography, oscillometry or X-ray arteriography.

Most patients who develop hardening of the leg arteries rather early in life are heavy smokers. I urge these patients to stop smoking (cutting down on tobacco is not enough) as soon as they are aware of the first symptoms.

When indicated, I also urge that the patients have X-ray arteriography. Thanks to modern vascular surgery, the narrowed portion of a blood vessel can occasionally be removed or bypassed by means of an artificial shunt. A sympathectomy (removal of part of the sympathetic nervous system) or a nerve-blocking procedure may also be helpful. Again, a careful search for diabetes is advisable because diabetes is so often a precursor of arterial disease.

When hardening of the arteries strikes the brain, the picture will vary considerably depending on which areas are involved. The classical example is that of a "stroke," in which there is paralysis of one side of the body. Mild and fleeting strokes (the "little strokes" described by Dr. Walter Alverez) may cause transient weakness, speech and visual disturbances or slight personality changes. On the other hand, severe strokes can lead rapidly to death.

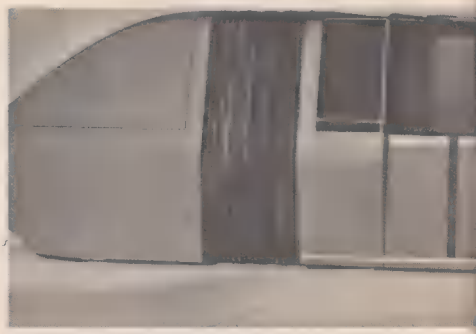
Since the hardened blood vessels are most often within the brain itself, they cannot be treated by a direct medical or surgical approach. But in some cases the sclerotic (hard) vessel is in the neck and the block or kink may extend only along a half inch or less of the artery. Such arteriosclerotic areas can sometimes be removed or bypassed through skillful surgery.

It must be pointed out that the body can manufacture cholesterol even when the diet contains no cholesterol at all. Cholesterol, especially dietary cholesterol, is obviously not the whole answer. I agree with Dr. Henry I. Russek, noted New York cardiologist, who says, "For too long, physicians have been preoccupied with the composition of the diet and the level of serum cholesterol in assaying the predisposition to coronary artery disease."

Dr. Russek points out that "stressful life experiences" can directly and indirectly lead to arteriosclerosis. Again, I agree. With our present knowledge, then, the best way to avoid arteriosclerosis is to practice a life of moderation — less food, less tobacco and less emotional and physical pressure. It takes a little effort to keep your arteries "young," but it's worth it.

NEW FOR INDUSTRY

Pipeline which can be inserted directly into old cast iron gas mains eliminates torn up lawns and cuts installation time in half. Workers in Milwaukee show how light glass/epoxy pipe is. Owens-Corning Fiberglas, 717 Fifth Ave., N.Y., N.Y.



Butterfly valves, like the 5-inch and 6½-ton varieties shown here, are used to control the flow of liquids and gases in heating and air conditioning systems, industrial processes and water works. By Rockwell Manufacturing, Pittsburgh, Pa.

Dr. Klaus Schmidt of Argonne National Laboratory, Argonne, Ill., tests new low-cost device developed there to study the hydrated electron, a new particle produced in water under irradiation. Because of the absence of hazards from intense radiation beams, the low cost and simple operation of device, it can be used anywhere and research on hydrated electrons can be expanded.

First electronic driverless, trackless passenger train for transportation in airports has been designed by Barrett Electronics Corp., Northbrook, Ill. Four trains are being installed in Houston Intercontinental Airport, scheduled to open this year. "Guide-O-Matic" trains will carry passengers third of mile in less than four minutes, with 23,000 capacity in day. Train follows single wire in floor.

Another airport train, only this one is for transportation between airport and downtown points. The stainless steel cars are to be put into service late this year between Cleveland Hopkins International Airport and the city's downtown business district. Tokyo, London and Brussels are only other cities having such facilities. By Pullman-Standard's Chicago Plant, Pullman Car Works, for Cleveland Transit.

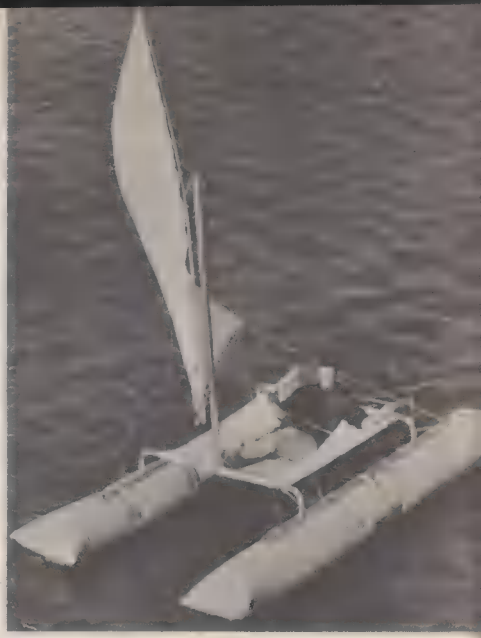
TECHNOLOGY

Student Design Winners

ALUMINUM Company of America's 1967 Student Design Merit Award Program developed a broad range of unique designs in aluminum. The winning designs illustrate the versatility of light metal in such diverse fields as medicine, farming and recreation.

The winning designs were selected by faculty chosen design professionals at each school where students participated in the contest. Final winners were determined on the basis of the criteria they established. The 1967 award recipients were the ninth group of industrial design students to be honored by ALCOA.

Robert P. Eganhouse, manager of design, explains that ALCOA's design education program includes visiting lecturers, a technical library on aluminum, metal for approved projects and an unrestricted grant of $1,000 to the industrial design department of each school. In the six schools involved in the full program, other schools with accredited design curriculum and programs are eligible for technical and material assistance from ALCOA.



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This aluminum catamaran weighs only 80 pounds when collapsed and is 12 feet long with a six-foot beam. Sail area is 95 square feet. Assembly requires no tools.

2
Advantage of lightweight Four-Stage Packframe is ease with which it may be altered in four stages to lower center of gravity for easier crouching or climbing.

3
Aluminum Hand Brace serves as splint for victim of hand paralysis but with partial wrist action. Brace slips over hand and forearm, enabling one to pick up objects.

4
Foot-pedal powered foolproof water pump shoots a stream of water over ordinary two-story house. It lifts water 22 feet at the rate of 14 gallons per minute.

5
This air-flow seating system is designed to control temperature and provide seating comfort. Seat is formed with an open grille-like surface of aluminum rods.

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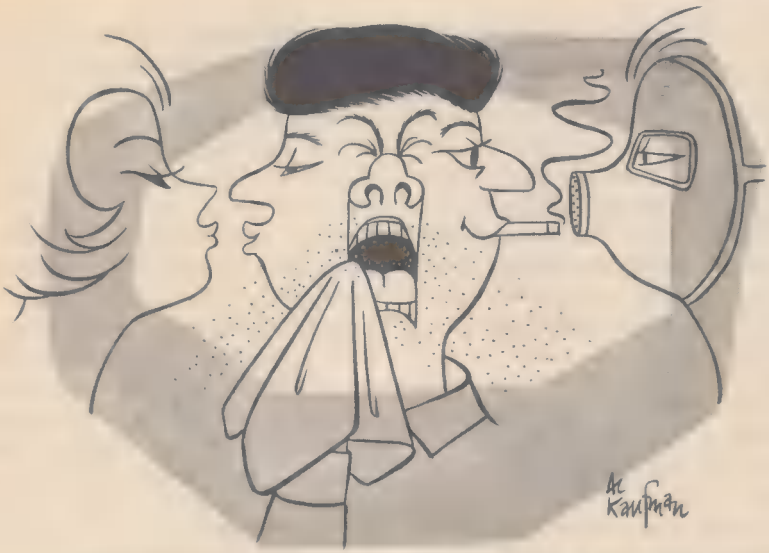
BIPS

A dog's best friend

A dog may be man's best friend, but it appears that this doesn't always work in reverse. Here's one canine who prefers the fine feathered type. The dog's owners found him one morning with the bird perched on his back, and the two have been inseparable since. Pigalle, the one with fur, is a prize-winning German Shepherd, while her companion, Ricky Romano, is a cocky budgerigar (also known as the Australian lovebird or zebra parakeet), which can chirp in three languages—French, Italian and English.



Psychiatry looks at love, smoking and the common cold

What is love? Why can't we stop smoking? Why do we feel so rotten when we catch cold? A group of psychoanalyists offer answers.

by Flora Rheta Schreiber and Melvin Herman

If you think love is a snare, you're right, according to Dr. Leonard R. Sillman of Westport, Conn. He said that, besides inspiring high and noble behavior, "love is intimately involved with a major portion of the inner psychic miseries—neuroses, perversion, thralldoms—and other personal and social misfortunes that plague the human race." He added, "Love contributes to the force which attracts the individual to self-destruction, attaches him to socially destructive institutions, ideologies and leaders who, in command of the loyalties which are derived from love, are rendered omnipotent to ravage, desolate and destroy." His report was one of a series delivered to a meeting at the American Psychoanalytic Association. Other speeches are also reported on in this month's column.

Dr. Sillman linked the negative aspects of love with the basic na-

ture of the primary erotic instincts which unfold in early childhood. "These impulses are permeated through and through with sadistic and egocentric drives," he said. What results are impulses toward cruelty and even indifference to the welfare of the loved one. Ironically, as Dr. Sillman put it, "from the very nature of eroticism comes an impetus toward the degradation of love into its opposite."

Still other complications arise as a result of the guilt, narcissism and aggression, which also stem from the process of coping with the environments in childhood. The growing child, and later the adult, develops a "heightened aggressiveness against anything deemed alien and threatening to whatever symbolizes the 'holy' child-parent bond." Excessive guilt arouses masochistic thralldoms, bondage, self-destructiveness and neurotic inhibitions which block the essential, preliminary sensual stages of love. "This prevents its fulfillment through substituting pain for the pleasures of the sexual instinct, creating suffering and failure instead of happiness and gratification."

Is love hopeless? Dr. Sillman's answer is that it fulfills itself only through what he calls the "grand creative transmutation" of eroticism into nurturing. This can take place only when animalistic sexuality with its sadism and egocentrism is changed by the restraining forces of the nurturing instinct into tenderness, altruism, protectiveness and self-sacrifice in devotion to the loved one.

Breathe, don't smoke

Heavy cigarette smokers who want to stop will have to find some form of respiratory substitute such as deep-breathing or breath-holding exercises, says Dr. Eli Marcovitz of Philadelphia. This is so because heavy cigarette smoking is primarily a respiratory addiction with unconscious purposes that the use of a pipe or a cigar do not fulfill.

It is difficult for heavy cigarette smokers to switch to cigars or pipes or to give up smoking altogether even though the dangers of smoking are well known to them.

Dr. Marcovitz, in advancing the respiratory substitute theory, contends that heavy cigarette smoking is characterized and differentiated from other forms of smoking by its dependence on inhalation. He considers exhalation and visualization of the smoke as important components of heavy cigarette smoking. By means of inhalation, exhalation and visualization, the smoker attempts to accomplish five unconscious purposes.

Purpose one is to feel the fullness of the interior of the body through the chest in smoking. It is commonplace in medicine to find people who eat in order to gain a sense of fullness of the interior of

the body because of the difficulties concerning their sense of self. "Deep inhalation of the cigarette smoke can be even more effective than eating to produce this sense of boundaries and of self-delineation," he said.

Purpose two is to find pleasure in breathing, which for many persons is enhanced by the increased sensory stimulation in the inhalation of cigarette smoke.

Purpose three is to use the cigarette as a scuba diver uses an airline to his tank, simultaneously to breathing and as a means of relieving the unconscious fear of suffocation.

Purpose four is to win loved ones or to conquer adversaries through a sense of omnipotence achieved through smoking. This process has parallels throughout human history, particularly in various primitive cultures in which the inhalation of smoke was a symbolic-magic method of incorporating the spirit of a god by whom one was then possessed and shared in his omnipotence.

Purpose five involves using smoke either as a screen on which to project unconscious fantasies or, through the amorphous quality of the exhaled smoke, to experience unconsciously as an externalization of the self the embodiment of one's own spirit and the proof of immortality. Some cling to a cigarette as a child to a mother in the presence of strangers.

In discussing the myth of Narcissus, who fell in love with his own image, Marshall McLuhan, in his book *Understanding Media,* said that, "Men become fascinated by any extension of themselves in any material other than themselves." Dr. Marcovitz adds that "seeing one's self in the form of one's own exhaled smoke is the reassurance that one exists.' He sees this as saying, "I smoke, therefore I am."

What goes up in smoke? he asks. It is the dream, the unconscious fantasy of the idealized self. The formlessness of smoke lends itself for the projection of the fantasy, the lost dream that every addict, not only the cigarette addict, constantly seeks to recover.

Recently, a patient, a young man in college, talking of his efforts to give up smoking "because it's a killer," tried to understand his repeated return to cigarettes. He was groping for words to communicate the feeling he had while smoking. There were different meanings in different situations. He first said it gave him a feeling of appearing sophisticated—"in"—a person with style. He went on, "I like the smoke coming out so smooth, like the breath, especially while I'm talking. It's like seeing the words. I don't care to smoke in the dark or when it's windy—then I can't see the smoke come out. And it's no good not inhaling. I don't like the taste if I keep the smoke in

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Miss Schreiber is an award-winning writer on psychiatry; Melvin Herman, the Executive-Secretary of the National Association of Private Psychiatric Hospitals.

my mouth and don't inhale, and also it doesn't come out in the same smooth way like the breath." Then, more pensively, he added, "When I'm with someone else the cigarette is like a third person, one who is on my side, an ally, he and I together against everyone else. When I'm alone, it's a companion. I never realized this before. It's alive, on fire. It's warm. I make real contact with it. I can watch myself consume it. I can control its life. I can 'kill it' when I want."

Cold in the head

The cause of the common cold is still unknown. Infection is now considered only secondary. Scientists think the enemies are the viruses known as rhinoviruses. However, there are more than 150 strains of rhinovirus and a person may have as many as 20 colds in a year and not duplicate viral strains. Furthermore, controlled experiments indicate that the common cold is not nearly so contagious as was formerly believed. Human volunteers have been inoculated with secretions from people who had colds and only caught colds 30 percent of the time.

On the other hand, people with chronic nasal symptoms have been found to be in life situations which give rise to conflict, resentment, humiliation and frustration.

All this evidence has led psychiatrists to feel colds may well be caused by emotions. This means that the common cold is a psychosomatic illness. Dr. Merl M. Jackel, of the State University of New York, Downstate Medical Center, explored this hypothesis for three years with 10 patients in psychoanalysis. He saw 35 colds, and depression was associated with 26 of them. This was not just the miserable feeling brought on by the cold. The depressed feelings invariably preceded the onset of the cold. Dr. Jackel reported on his study at the meeting of the American Psychoanalytic Association. Although all the colds but one came at a time when the patients were depressed, of course, they were depressed at times without developing colds.

Dr. Jackel believes that the feelings of fatigue, loss of energy and malaise so frequently associated with colds, may well be manifestations of depression rather than the toxic effect of the germs, and that colds are affected by emotional situations of which one is not conscious. Repressed anger and hostility were frequently present in his patients who suffered from colds.

In the patients with colds, no other factor was observed with anywhere near the same frequency as depression. Fourteen times the cold was reported on a Monday. This was the first day back under the analyst's care after the weekend or week-long separation. Seven times, colds were reported on a Friday, the day before a projected separation.

Mexican cactus is chopped, dried and then analyzed for traces of LSD-like alkaloids at Texas Christian University laboratories.

Cactus cut-up

Most people ignore the cactus unless brought forcibly in contact with one. But in recent years some people have taken an intense, even illegal interest in some kinds of cactus because they contain hallucination-producing compounds similar to LSD. The chemical that causes the hallucinations is a naturally-occurring alkaloid.

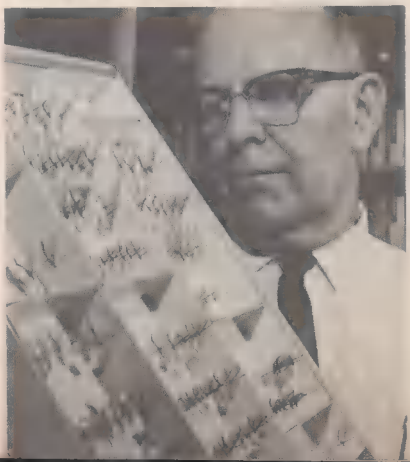
Dr. Joe E. Hodgkins of *Texas Christian University* in Fort Worth became interested in studying cactus alkaloids after medical researchers suggested that schizophrenia and other mental diseases may be caused by chemicals in the body similar to the alkaloids found in cacti. But Dr. Hodgkins realized that only 65 of the 1,230 known species of cacti had ever been analyzed for alkaloids.

To help fill this information gap, doctoral student Stan Brown spent three weeks traveling around the mountains and deserts of Mexico. He collected over a ton of cactus, which was dried and shipped back to TCU for analysis.

Not all alkaloids are hallucinogenic. An alkaloid found in a South American vine, for instance, is so potent that it has been used as a poison for Indian arrows. Under highly controlled conditions, this same alkaloid is now used as a muscle relaxant in surgery.

One alkaloid discovered by Brown was found to affect the emotional center part of an animal's brain—and only that part.

Some people collect stamps or coins. Dr. George F. Edmunds Jr. and his colleagues at the University of Utah collect mayflies, and they have the world's largest collection. They use the insects to study the varying paths of evolutionary development.



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1. Johns Hopkins technician Robert MacQueen conducts one of the many tests of telescopes prior to eclipse. 2. An overall view of the high altitude desert which held the campsite of the astrophysics team during the eclipse experiment. 3. Group photo of the astrophysics team. 4. The remote campsite became an object of fascination for people who lived in surrounding areas, and for others who traveled as far as 200 miles to get a look at the scientists. One of the natives is shown examining a piece of dry ice that was used to cool the infrared detection system. 5. A soldier on loan from the Bolivian Government stands guard to prevent natives from interfering with work of the scientific team. 6. Bearded and sunbrowned technician Bill Dalton checks recorder equipment. 7. While one scientific team watched the eclipse from the Bolivian mountains, another team of Johns Hopkins scientists launched a balloon carrying an infrared coronagraph from a field in Palestine, Texas. The balloon carried the instrument to a height of 912,000 feet. Purpose was to examine the sun's corona.

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Long haul—short look

Months of planning, weeks of travel and more weeks of dawn-to-dusk last minute work—all for a 92 second look at a solar eclipse.

A little over a year ago three scientists from *Johns Hopkins University* and eight from the High Altitude Observatory in Boulder, Colo., journeyed high into the Bolivian Andes, taking with them an almost incredible amount of equipment.

For two weeks the scientists and technicians labored nearly every waking moment assembling the complex infrared telescope and its attendant gear. Everyone knew that if the equipment was not working perfectly, there would be no second chance at the eclipse.

"Maybe that's why the cards and the chess sets were never used," said technician Bill Dalton of Johns Hopkins. "We were simply too tired by the time it got dark to do any more than sleep."

Headquarters for the expedition was a desolate mountain valley 13,000 feet above sea level. "I guess the first thing we really noticed about our new home," said Bob MacQueen, another member of the Johns Hopkins party, "was the absolute silence."

The altitude created difficulties in breathing. "By the time we got back to the States," said MacQueen, "our chests had grown an inch."

It was worth all the trouble. The eclipse occurred on a clear day and the experiments were carried out successfully.

MEDICINE

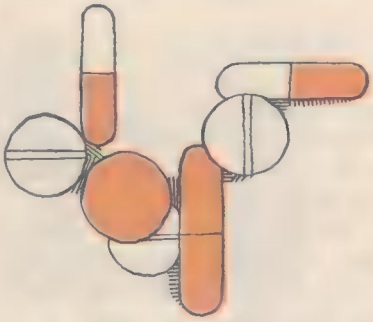
The wonder pill that does 'nothing'

by Arthur J. Snider

ADVENT of the wonder drugs and tranquilizers has all but eliminated placebos from the doctor's black bag.

But the phony pills have come back more prominently in a new role—keeping new drugs honest.

A New York University medical professor says scientific investigators are making increasing use of



placebos to test the effectiveness of new drugs.

If the bogus pills do as well as the real thing, it is apparent that the suggestive effect inherent in the tested drug is responsible for its benefit and not its pharmacologic action.

"Placebos serve to eliminate bias on the part of the physician," explains Dr. Frances Pascher.

Doctors have realized for decades that they could treat many patients successfully for real or imagined ailments by a little therapeutic hanky-panky. Brightly-colored but inert capsules prescribed with authoritative assurances would usually relieve such patients of their complaints.

To add to the effect, the potion usually was made bitter or given an exotic name like "fluid extract of black cohosh."

When the sophisticated era of drugs arrived after World War II, doctors had real weapons and no longer had to rely on medical make-believe.

Doctors never cease to be amazed at the power of blank pills to bring about not only an improvement in the patient, but even to create some of the same adverse side effects of actual drugs.

Some patients will complain of trembling, dry mouth, vomiting, stomach pain and even skin rashes after taking pills having no more fire power than an empty cartridge.

Trying to pick out "placebo-reactors" from non-reactors is not as simple as it might appear, Dr. Pascher says. She cites studies in which medical students given placebos developed side effects such as nausea, headache and drowsiness.

A recent study showed how

placebos can save money. A group of diabetic patients on sulfa drugs was shown to maintain as good a control with placebos. The investigators wrote in the *New England Journal of Medicine:*

"For whatever reason, the fact that a total of 139 carefully screened subjects could not be shown to need the medication they were thought to require is of some clinical concern. Without a placebo challenge, such patients would have continued on their regular medication, possibly for years, incurring a needless economic burden as well as a needless risk of untoward drug reactions."

No skin game

Like everyone else in this era of the image, skin specialists want to put their best face forward. But they are saddled with two cliches widely quoted by irreverent colleagues in other medical specialties:

- Dermatologists are only wart and acne doctors.
- Patients of dermatologists never die and never get better. They just keep coming back.

Neither cliche bothers Dr. E. William Rosenberg, professor and chairman of the department of dermatology, University of Tennessee Medical School.

"Warts are extraordinarily interesting scientific phenomena," he points out. "Here is the only tumor in humans proven to be caused by a virus. The cancer people are still looking for their virus. We've got one."

"Moreover, there's nothing like the lowly wart to keep a doctor humble and in his place. In my opinion, management of patients with warts saves dermatologists from the pomposities of some other practitioners and accounts for the fact that dermatologists are, by and large, the jolliest and best-natured of all doctors."

As for acne, its teenage victims deserve sympathetic consideration, not disdain, he declares, adding:

"Contrary to some beliefs, treatment of acne has undergone a real revolution. It is now a highly treatable disease. We have an understanding of the hormones that drive the oral glands and we know how to manipulate the bacteria with antibiotics."

Do dermatologists' patients ever recover?

"That old saw arises from the failures that walk around for all to see," Rosenberg replies. "But the fact is that there is a very high cure rate in skin diseases. A third of the patients will be cured in the first visit. Others may need two or three visits. Of course there are some chronic conditions, like psoriasis, that need continuing care if being given a drug like methotrexate, for example, that requires a weekly blood count."

A source of gratification, he contends, is solving cases that other practitioners have bungled.

"Here we have a patient who has a rash around his toes and has been treated for 20 years for athlete's foot," he asserts. "It turns out to be an allergy to some chemical used in the manufacture of shoes.

"Or the woman who comes in with a dermatitis over her eyelids and on the side of the neck. For years she's been told it's her nerves. You look at her and see it is a typical picture of a woman who is allergic to nail polish, brushing her fingers against her eyes and touching the side of her neck. Change her brand of nail polish and she's cured."

The electric dentist

Can't tolerate the dentist's needle when he injects novocaine? Try a little electricity.

Sedative effects are obtainable in anxious patients by running an alternating electric current of low milliamperage through the brain as the patient sits in the chair. The current is introduced via electrodes placed over the eyes and at the back of the head.

"Patients are conscious, in full control of their reflexes and able to respond verbally at all times," says Dr. Sylvan M. Shane of Boston. "They are mentally and emotionally relaxed to a degree attainable in the past only by use of sedative drugs administered intravenously or intramuscularly."

The electric method enables the patient to leave the dental office immediately after the current is switched off without having residual effects of drug sedatives he otherwise would have taken.

Electric currents through the human brain have been applied many times in the past for the purpose of inducing sleep, treating psychiatric patients and providing anesthesia for surgery.

The Russians have reported recently on their work with light "electrosleep," pointing out that one or two hours are equivalent to seven or eight hours of natural sleep.

The idea of using electricity for sedation occurred to Dr. Shane after a visit to the Neuropsychiatric Institute in Moscow, where electrosleep (not electroshock therapy) was used to treat patients with mental illness.

Dr. Shane has avoided using electricity to induce total anesthe-

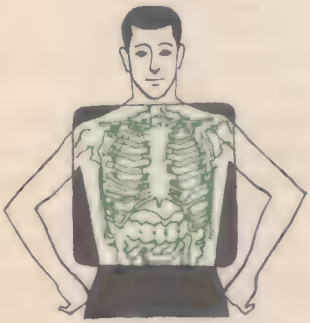
sia because of possible blood pressure elevation.

Pain relief is obtained through conventional use of drugs in the oral cavity, a procedure to which a patient under the sedating flow of electricity no longer objects.

Before trying electrosedation, Dr. Shane used a mixture of four drugs to produce apathy, sedation and amnesia. But when the patients left the office they had to be escorted and then had to stay in bed for several hours.

Fluoroscope 'freeze'

The television "stop-action" technique on the football field has been



extended to the losing coach's ulcer in the medical clinic.

Doctors can now "freeze" any image in fluoroscoping the patient. Fluoroscopy is the continuous X ray viewing of the body, a moving picture of bones and soft tissue.

The new system permits the doctor to study the X ray image for as long as he chooses without adding any radiation input to the patient's body. Doctors say it can reduce by 10 times a patient's exposure to X rays during a typical fluoroscopic examination. The new equipment was developed by Westinghouse Electric Corp.

Another 'pill' problem

Another possible complication of the birth control pill—an outward turning of one or both eyes—is reported by Dr. Stanley E. Roever, optometrist of Clinton, N.J. He says the evidence is not yet sufficient to term it a cause-and-effect relationship, but the association "appears to be striking."

He has found divergence in 19 of 48 women who on questioning said they were taking the pill. The 29 others showed no divergence, but had other symptoms. Duration of pill-taking ranged from two weeks to four years. No physiological basis for the symptom could be found in the laboratory in a series of chemical tests on one patient.

The divergence is not apparent to the observer. It must be measured to be found. Even though not visible, divergence can affect the patient's vision and cause headache and fatigue. In one case, divergence was so severe that double vision resulted. The brain ultimately suppressed the diverged vision to resolve the conflict.

Two patients who stopped taking the pill had complete recovery. In two others, visual treatment was unsuccessful.

Twenty of the 48 patients on the pill had "accommodative losses." Accommodation is the ability to see an object in the distance clearly and, the next instant, one that is near. Their accommodative capacities resembled those of much older people.

Dr. Roever said he did not recommend stopping the pill until the patients had consulted with their family physicians.

AMA's facts and fantasies about food

Because food occupies a place of such prominence in the lives of most people, quite a few superstitions and misconceptions about food have arisen.

Among the more common fallacies about food, says "Today's Health Guide," the American Medical Association's health information manual, are the following:

- If a few vitamins are good, more must be better. *(Not true.)*
- Never give milk to a patient with fever. *(The milk will not affect the fever at all.)*
- Beets build blood. *(They don't.)*
- Pork is indigestible. *(It's no more so than other meats.)*
- Sour foods, such as lemon juice or sauerkraut, can cure diabetes. *(They can't.)*
- Grape juice, honey, dried poke berries, carrot juice and tomatoes are helpful for treatment of arthritis. *(They're not.)*
- Cooked cereals heat the blood. *(Not true.)*
- Warm bread may cause a stroke. *(It won't.)*
- Putting cream in coffee makes the coffee more harmful. *(No, it doesn't.)*
- Ice water causes heart trouble. *(It doesn't.)*
- Raw vegetable juice contains life-giving properties, but cooked foods are "dead." *(Not true.)*
- Olives, oysters and raw eggs increase sexual potency. *(Not so.)*
- Wine makes blood. *(No.)*
- White sugar is not good for the health. *(Not true.)*
- White bread is poisonous. *(No, it isn't.)*
- If the expectant mother holds her weight down, the size of the baby will be reduced. *(Not a fact.)*
- Enriched candy is good for reducing. *(Sorry, but it isn't.)*
- Calories don't count. *(Afraid they do.)*
- Melba toast has no calories. *(Yes it does.)*
- Never eat rabbits, because they are all disease carriers. *(Not true.)*
- Yogurt and brewer's yeast are dietary requirements. *(They aren't.)*

ZOOLOGY

Opossum: a genuine fraud

Is an opossum playing when it "plays possum," or does it really lose consciousness?

The opossum, the only native marsupial in North America, is famous for its way of "playing" dead when an enemy threatens it. The animal certainly looks unconscious at this time. It lies curled on one side with its mouth open and its tongue sticking out. If you pull its whiskers or bend its toes, it doesn't move. It doesn't seem to be breathing, and its heartbeat slows. If the opossum is left alone, it usually begins to "wake up" in a few minutes. Raising its head, it listens, looks and sniffs for danger. If all is safe, it rushes away.

Some authorities have theorized that the opossum becomes temporarily paralyzed when it's frightened, possibly as a result of the action of a mysterious substance in the nerve centers.

But a team of California biologists has come up with the opposite theory: the opossum is just pretending. They base their conclusion on the results of tests with an electroencephalograph (EEG) machine which detects the activity of the brain. The tests are described in a recent *Nature and Science,* a publication of the American Museum of Natural History.

The biologists caught several opossums themselves and toted them back to their laboratory for the tests. Wires from the EEG machine were attached to each opossum's head and tracings taken while the animal was awake and asleep.

Then each opossum was "attacked." A loud speaker broadcast a recording of a dog barking as a big pair of pliers representing dog jaws grabbed the opossum by the neck and shook it. The opossum hissed, tried to fight and then "played possum."

Next, the biologists tried attacking the opossums with a real dog.

EEG tracings from both tests showed no unusual brain activity while the animals "played" dead. The activity was that of normal, awake, alert animals.

Opossums, the scientists concluded, are just faking.

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.

The fourth dimension

What is the fourth dimension?

The word "dimension" is from Latin and means "to measure completely." Let's try a few measurements, then.

Suppose you have a line and want to locate a fixed point, X, on it in such a way that someone else can find that point from your description. You make a mark anywhere on the line to begin with and label it "zero." You then make a measurement and find that X is just two inches from the zero mark. If it is on one side you agree to call the distance $+2$; if on the other side, it is -2.

Your point is located, then, with a single number, provided everyone agrees on the "conventions"—where the zero mark is and which side is plus, which side minus.

Since only one number is needed to locate a point on a line, the line, or any piece of it, is "one-dimensional" ("one number to measure completely.")

Suppose, though, you had a large sheet of paper and wanted to locate a fixed point X on it. You begin from your zero mark and find it is 5 inches away—but in which direction? You can break it down into two directions. It is 3 inches north and 4 inches east. If you call north plus and south minus, and if you call east plus and west minus, you can locate the point with two numbers: $+3$, $+4$.

Or you could say it was 5 inches from the zero mark at an angle of 36.87° from the east-west line. Here again are two numbers: 5, 36.87°. No matter how you do it, you must have two numbers to locate a fixed point on a plane. A plane or any piece of it is two-dimensional.

Suppose now that you have a space like the inside of a room. A

fixed point, X, could be located as 5 inches north of a certain zero-mark, 2 inches east of it, and 15 inches *above* it. Or you can locate it by giving one distance and two angles. However you slice it, you will need three numbers to locate a fixed point in the inside of a room (or in the inside of the universe.)

The room, or the universe, is therefore three-dimensional.

Suppose there were a space of such a nature that four numbers, or five, or eighteen, are absolutely required to locate a fixed point in it. That would be four-dimensional space, or five-dimensional space or eighteen-dimensional space. Such spaces don't exist in the universe, but mathematicians can imagine such "hyperspaces" and work out what the properties of mathematical figures in such spaces would be. They even work out the properties of figures that would hold true for any dimensional space. This is "*n*-dimensional geometry."

But what if you are dealing with points that aren't fixed, but that change position with time? If you wanted to locate a mosquito flying about a room, you would give the usual three numbers: north-south, east-west, and up-down. *Then* you would have to add a fourth number representing the time, because the mosquito would have been in that spatial postion for only a particular instant, and that instant you must identify.

This is true for everything in the universe. You have space, which is three-dimensional and you must add time to produce a four-dimensional "space-time." However, time must be treated differently from the three "spatial dimensions." In certain key equations where the symbols for the three spatial dimensions have a positive sign, the symbol for time must have a negative one.

So we mustn't say that time is *the* fourth dimension. It is merely *a* fourth dimension, and different from the other three.

—*Isaac Asimov*

What is the peck order?

The term peck order was originated in 1922 by a Norwegian scientist T. Schjelderup-Ebbe. Schjelderup-Ebbe had studied many species of birds, including domestic fowl. He found that in some groups of birds there is one bird that is boss of all the rest. Below the top bird is a second ranked bird, and so on down the line. These social relationships are first established by actual fighting (pecking). The winner becomes the dominant bird; the loser, subordinate.

Fighting does not go on constantly. After the ranking is established, a single peck or even a threatening gesture is enough to send a subordinate bird into retreat. The dominant bird is able

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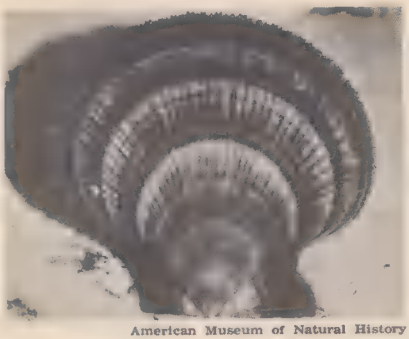
to move about freely, and gets the best food.

The peck order serves a definite function among animals which are both social and aggressive. It operates among mammals as well as birds, although the word is inappropriate because mammals clearly do not "peck." Still the principle is the same. What the peck order does is reduce fighting within the group. After the first fight each animal has its clearly defined place, and the fighting need not be repeated.

In experiments among domestic hens, it has been found that a hen removed from a group will retain its social status for about two weeks. After that she must fight her way into position again. A severe disruption of the peck order can cause serious consequences for a group. Among the hens fewer eggs are laid. Among some other animals, serious fighting to establish a new peck order can break out.

Animals have developed a series of complex signals or "threats" to display their dominance. There is also a whole series of submissive postures, by which a lower ranked animal defers to one higher in the peck order. Among wolves, for example, the superior wolf stands erect with his tail up and his hair bristling. He bares his fangs and growls. The weaker wolf crouches and carries his tail and ears low.

When the animals' positions are this clearly defined, they rarely, if ever, engage in any real serious combat.



American Museum of Natural History

The shell game

by John and Molly Daugherty

A scallop is the pilgrim's symbol. In the eighth century, pilgrims going to the shrine of Saint James at what is now Santiago de Compostela, Spain, took shells back home to prove they'd made the trip. (The scallop was the symbol of Saint James, the fisherman.) Natives gathered the shells on Mediterranean shores and took them inland.

You can find shells anywhere, however—at sea, on land and in fresh water. A rare shell, the *Conus gloria maris*, of which few specimens are found, has been valued at more than $1,200.

What do you know about shells?

1. Natural pearls form in the pearl oyster
   a. As eggs develop in hens
   b. In its effort to avoid discomfort
   c. With regularity once a year

2. One mollusk is a symbol of good luck and long life to the Japanese. Their gift packages often include colorfully wrapped thin slices of the dried meat of this animal. The good-luck mollusk is the
   a. Abalone
   b. Periwinkle
   c. Conch

3. The shells for making cameos are found among
   a. Wentletraps
   b. Cowries
   c. Helmets

4. With a few exceptions, mollusk animals have hard shells which grow with them. The growth of the shells is
   a. A continuous process
   b. A periodic process
   c. An unknown phenomenon

5. The number of shell species of all classes of known mollusks is about
   a. 100,000
   b. 250,000
   c. 50,000

6. Single-shelled univalves make up the largest class — the gastropods. Pelecypods, the second largest class (bivalves) includes oysters, mussels and clams. The mollusk among these that grows biggest in size is the
   a. Oyster
   b. Mussel
   c. Clam

7. **Experts judge the value of pearls on many points, but usually first in determining value come**
   a. **Texture and color**
   b. **Freedom from blemish**
   c. **Shape and shining quality**

8. **To avoid a venomous mollusk, the stab of which could be fatal, beware of some varieties of**
   a. **Cockles**
   b. **Cones**
   c. **Cowries**

9. **Snails are mollusks. One of these snails was the source of dye in the time of the Phoenicians and led to a flourishing industry. This snail was the**
   a. **Natica snail**
   b. **Moon snail**
   c. **Murex snail**

10. **The best time for collecting live shells is at**
    a. **High tide**
    b. **Low tide**
    c. **Midway between high and low tide**

Answers:

1 - b In its effort to avoid discomfort. When sand or other material lodges in the soft body of the oyster or between its shell and mantle, the animal covers the object with a liquid which hardens quickly into a smooth coat. As the process of coating continues again and again, the pearl grows in size. Narce, the liquid, is the same as that which forms the mother-of-pearl lining of the shell.

2 - a Abalone *(Haliotidae)*. The muscular foot is a food delicacy. Abalone is a staple Oriental food, as well as a symbol of good luck and long life to the Japanese.

California, to keep its coastal waters from being depleted of abalone, now limits abalone fishing and exporting.

3 - c Helmets *(Cassididae)*. Several varieties of helmet shells may be used. Many tons of red helmet shells *(Cypraecassis rufa)* are shipped to Italy from Africa to make fine cameos. Black and yellow helmets are two of the choice shells (for cameos) found in American waters.

4 - b A periodic process. At times, growth slows down or even stops. State of activity, environmental conditions and food supply affect growth. Liquid secretions of calcium carbonate flow from glands along the edge of the mantle (the fleshy lining of the shell). When mixed with colloidal albumin, also supplied from glands of the mantle, the liquid crystallizes to form additions to the shell. Other glands over the area of the mantle supply secretions to build the shell in thickness, too.

5 - a 100,000. Most mollusks belong to the gastropods and pelecypods. There are three minor classes: Scaphopods — tusk and tooth shells, cephalopods — chambered nautiluses, and amphineurans — chitons or coat-of-mail shells.

6 - c Clam. The giant clam *(Tridacna gigas)* of the Southwestern Pacific and Indian Ocean waters may reach 40 inches in length and 500 pounds in weight. It is a vegetarian with a possible life span of 100 years. The cone, in contrast, is carniverous. It eats fish and even eats members of its own family.

7 - c Shape and shining quality.

The luster is called its *orient*. The quality of the shell lining and of the pearl depends on the chemical content of the water, the type of food supply (microscopic organisms) and the temperature of the water and its saltiness.

8 - b Cones. Some cones *(Conidae)* are harmless, but others are deadly. Among the poisonous cones found in warm Pacific waters are the textile, tulip, geography, marble and courtly cones.

The cone has a long retractable fleshy tube for a proboscis. Poisonous ones have five or more harpoon-shaped needles for stabbing enemies and injecting the venom.

Cones found in American waters usually aren't the poisonous variety.

9 - c Murex snail *(Murex brandaris)*. The Phoenicians made a rich purple dye known as "Tyrian purple" by crushing vast numbers of Murex snails. Demand for the dye was so great that the Phoenicians colonized many parts of the Mediterranean in search of new beds of snails. When the Romans took over, only royalty could wear this purple.

The glands on the wall of the mantle of the snail first exude a milky white fluid, which on exposure to sunlight goes through a series of color changes ending in red-purple.

10 - b Low tide. Especially the extra low tides or minus tides. Some kinds of shells can be found at no other time. Often all you see of some specimens are their siphons sticking up out of the mud or sand. If you dig one up and place it on the surface, you'll soon see its foot emerge to dig under again.

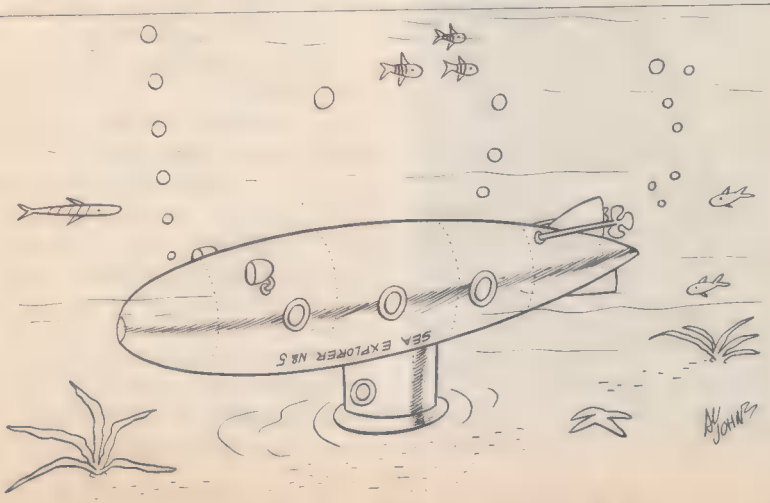
Another time to look for live shells is right after a severe storm, when many shells may be washed ashore.

Score yourself:

9 - 10 right—You'd be a good malacologist!

4 - 8 right—The shell world isn't quite your oyster.

0 - 3 right—You were a real clam.



". . . Other than that, we're down successfully."

How to tell your friends from the apes

(Apologies to the late Will Cuppy)

The Apes. Vernon Reynolds. E. P. Dutton. ($10.00)
The Naked Ape. Desmond Morris. McGraw Hill. ($5.95)
The Great Monkey Trial. L. Sprague de Camp. Doubleday. ($6.95)

This is "the month of the great apiary" in literature—a carnival of monkey business that takes us all the way from the primeval primates up through guess who.

Each book is, in fact, a serious, important and fascinating contribution to a fascinating field: *us* and our relationship — sometimes distant, sometimes distressingly close —to our hairy anthropoid cousins. What's distressing is the fact that so often the hairy cousins come up more appealingly shy, gentle, peaceable and charming than we do. Even the mighty gorilla, for centuries depicted as a vicious, aggressive monster given to unprovoked attacks on helpless humans, is now known as a generally good natured fellow whose aim in life is to be left alone.

Mr. Reynolds, a British primatologist, has produced a remarkably thorough book that probes the jungle of evolution. He traces apes from tertiary times through an era of adventurers' misinformation, to—at last—modern scientific studies in the natural habitat. Gibbon, orangutan, chimpanzee and gorilla go under the microscope in turn. The author has some interesting theories. Chimps, he points out, use sticks and stones as weapons (there's a great photo of a mother chimp heaving a log at a fake leopard), and make insect-digging tools from sticks. "Why have high intelligence and skills developed in a forest-living ape that does not appear to need them?" he asks.

For an answer, he quotes Dutch zoologist Adriann Kortlandt, who postulated the theory that once apes and primitive men lived in semi-open country; man forced apes back to the forest because they were unable to compete. Chimps were last to quit.

Another intriguing idea: since most of our first knowledge of apes sprang from rumor and folklore, Dr. Reynolds suggests that there may well be one more still "undiscovered" ape: the Yeti! He has some interesting reasons.

Instead of looking at man via the apes, Desmond Morris looks at the ape in man. The view will not please sensitive folk. *The Naked Ape* is not flattering; nor was it meant to be. "Despite our grandiose ideas," says the author, "and our lofty self-conceits, we are still humble animals, subject to all the basic laws of animal behavior." His book, comparing human behavior with that of the apes, makes some startling points in the thesis.

To complete the picture, L. Sprague de Camp has given us a meticulous white paper on the famous Scopes trial that began on a hot July day in 1925 in Dayton, Tenn. This was the free-for-all over the issue of whether or not the theory of evolution should be taught in Tennessee's schools. It was triggered by George Rappelyea, an honest, angry man infuriated by the prejudices of local bigots, and centered around John Scopes, a Dayton science teacher who taught evolution to flaunt the law. Scopes became the "pigeon" for a bizarre battle between Clarence Darrow and William Jennings Bryan—and the case (Scopes lost!) went down as a colossal disgrace to the intellectual stature of America. How it happened is all here in vivid carnival hues. Excellent reading and nicely infuriating still.—*RFD*

Other new books of interest

The Psychology of Children's Art. Rhoda Kellogg with Scott O'Dell. CRM-Random House. ($10.00). This fine collection of artwork of children from age 2 not only shows a remarkable resemblance to such artistic greats as Picasso, Chagall and Klee, but offers evidence that all children, regardless of their nationalities, go through the same stages of development. The creativity of children and the intensity with which they create is something the adult would do well to notice.

The Story of Science in America. L. Sprague de Camp and Catherine de Camp. Charles Scribner's Sons. ($4.95). The authors trace America's scientific history—from its backward days prior to the Revolution, to its place at the top today. Pioneer scientists and inventors like Cotton Mather, Benjamin Franklin and Thomas Jefferson helped to instill interest in science, but, as

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the book describes, it wasn't until the latter part of the 19th century that the value of science in education was accepted by a majority of Americans.

Light for the World. Robert Silverberg. D. Van Nostrand. ($5.95). Thomas Alva Edison said, "We will make electric light so cheap that only the rich will be able to burn candles." This inventor did much more than this, of course, but he will always be best remembered for having given light to the world. This is both a biography of the great inventor and of his great invention.

Other Worlds Than Ours. C. Maxwell Cade. Taplinger Publishing Co. Inc. ($4.95). The age-old question of whether there is life on other planets is once again raised, but in this instance, the author presents assorted theories on the subject, both past and present. He also delves into the evolution of the earth, the birth and death of stars and planets and folklore, flying saucers and the coming of the robots.

The Earth in Space. Edited by Hugh Odishaw. Basic Books. ($6.95). The 30 chapters that comprise the book are based on a series of lectures prepared for the Voice of America—all dealing with what astronomy, astrophysics, geophysics and related fields have learned about the earth, the solar system and galaxies.

Idea of the Month

The talking computer

A calculator invented by a New York lawyer-engineer answers when spoken to. The robot machine is designed to listen to a voice-delivered problem, figure the result and announce it orally.

The inventor is Walter H. Stenby, who got an engineering degree from the Institute of Technology in Vienna and, after coming to this country, took courses in phonetics at New York University. He is a member of the bar and patent attorney.

A recent patent (3,356,836) protects the talking computer. The announcer arrangement represents an improvement over apparatus Mr. Stenby patented in 1965, which was speech-controlled but responded in visible figures, having no voice of its own.

The arithmetic is done by a standard 10-key calculator. To strike the digit 1 [one], the operator really pronounces into the microphone three phonetic sounds: W, u and n. The inventor has simplified the dictation sounds so that foreign-born Americans will have no trouble.

The command for the figure eight, for example, sounds like "aid," and the code avoids confusion of the "s" sound with "th" and "z."

After the figures are in, a command to add, subtract or multiply may be given. The inventor does not allow for any sloppy reporting by the machine itself. Clearly enunciated sounds are recorded for zero through nine, so that results given by the machine will be clearly understood.

"I do not have a model," said Mr. Stenby recently, "since the apparatus is not the kind of machine you can build in the basement. This would require the development facilities of an industrial firm with experience in the computer and calculator field."—*Stacy V. Jones*

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46 chromosomes

I believe that J. A. Graham in his article, "Chromosomes and crime" (Dec. 67), has made a mistake on the number of chromosomes in the somatic (body) cells. Mr. Graham put the number at 48. I have checked two sources, Buettner-Janusch's "Origins of Man," and Ashley-Montagu's "Human Heredity." Both give the somatic number as 46. A footnote in "Human Heredity" stated, "Until 1956 it was believed that the number (chromosomes) was 48. It has now been established that there are only 46."

JOHN W. SARKISIAN
Lincoln Park, Mich.

You, and many other people who have written in, are quite correct in that there are only 46 human chromosomes, not 48.—Ed.

UFOs — tornados?

I just want to say "thank you" for the fine article, "A new look at the UFO enigma," (Nov. 67). I'm sure this article explains a lot of UFO sightings. Having worked in research of atmospheric phenomena for the past 12 years, I am aware there are many electrical phenomena as yet not understood by man. I further suggest many UFOs to be "miniature tornados" devoid of the dark clouds that mask the true nature of the normal tornado. The usual tornado discharges the electrical potential of its environment along the ionized path of particles near its verticle core or funnel. I suggest the UFO to operate in much the same manner, but to discharge opposing polarities between two air layers. We might say simply that the tornado and at least some UFOs are but the "armatures" of atmospheric "space motors."

JAMES H. STEGNER
Jennerstown, Pa.

Magazine saver

My son has subscribed to, and saved, *Science Digest* for six years. Your magazine has helped keep alive his interest in the sciences. He is a physics major with astronomy, chemistry and math running in close competition with each other at college.

MRS. D. M. CORDROY JR.
Phoenix, Md.

The good old barber shops

Had the psychiatrists of "Barber shop phobia" (page 64, Dec. 67), explored barbering rather than barbers, they would have arrived at better answers. Practicing the correct course over the face and wielding a sharp straight edge razor correctly over stretched skin, it is next to impossible for a barber to cut or imagine he could cut someone. Whether he'd arrive at the notion of deliberately mutilating someone is

another thing. Individuals with time to entertain suspicions, misgivings and the like take something away from the familiar easy going way that marked the ancient barber of hot towel and suds. After all, a hair cut is about all one can't manage for oneself, and there is some effort to dispute that.

MAYNARD M. PIERCE
St. Louis, Mo.

A question of billions

In the December 67 issue, Isaac Asimov's article on the nuclear age stated, on pages 47 and 48, "Someone may accidentally discover, for instance, that in the presence of a stream of a certain variety of meson under certain conditions, hydrogen nuclei will fuse at temperatures of merely billions of degrees rather than hundreds of millions." Was this written for the person who is always looking for mistakes?

JOHNNY JOE DAVIS
Sweetwater, Okla.

You are right. That should have read "merely millions of degrees rather than hundreds of millions." This was a typographical error and not Dr. Asimov's.—Ed.

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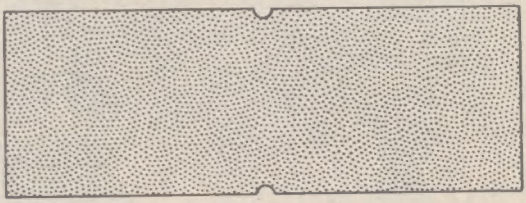

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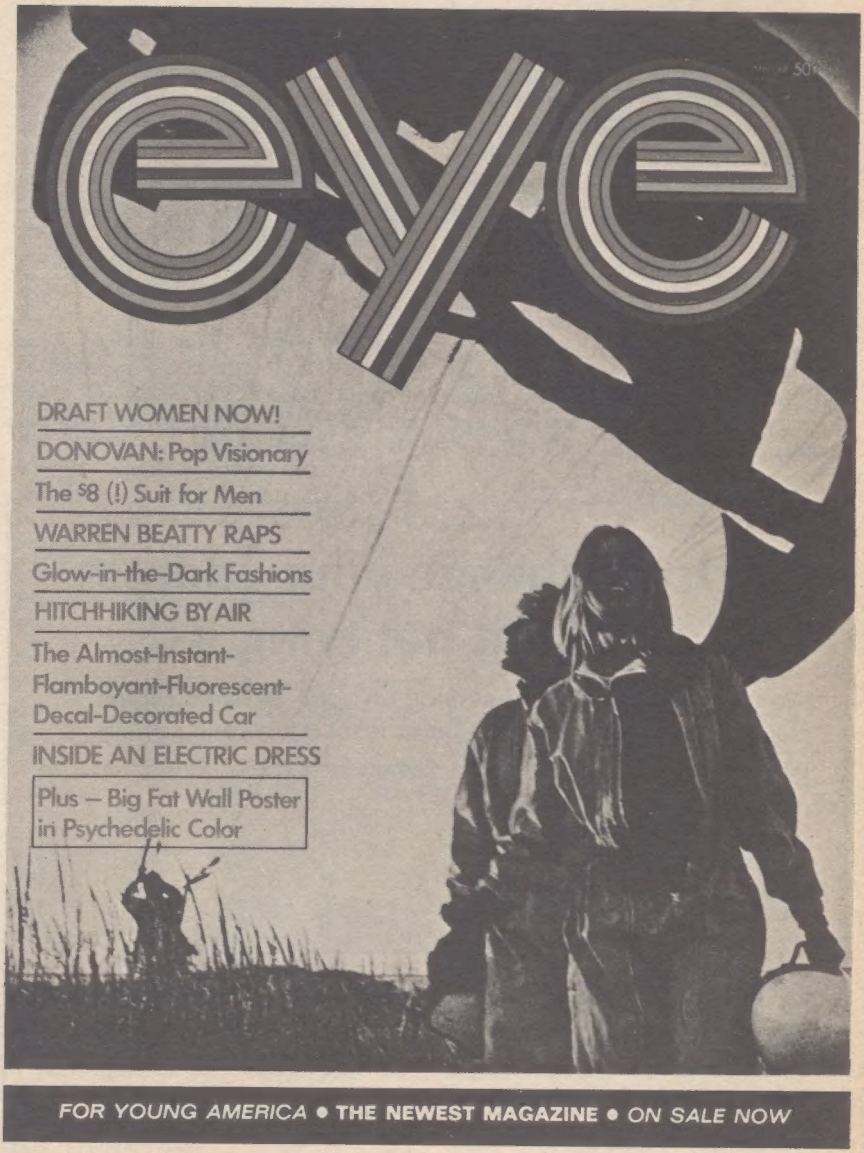
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Keystone

Walking on water?

TAKING a quick stroll through the muddy waters of the Tallahachie? Actually, no. The birds, bald coots, are familiar sights on many lakes in Southern Germany. Here they are seen running across the surface of a lake, but notice that they stay above water by constantly moving their wings while "running." And they leave behind them a most interesting succession of circular patterns in the water.